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**Urban Mass
Transportation
Administration**

The MVRTA Charge-A-Ride Program: Credit Card Fare Post-Payment in Haverhill, MA

UMTA/TSC Evaluation Series

Final Report
March 1988

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16. Abstract

This report presents an evaluation of a demonstration of automated fare collection using on-board credit card readers and recorders on general revenue service buses in Haverhill, Massachusetts. The demonstration project employed a credit card system for fare post-payment which was administered by the local transportation authority. The demonstration was in part unique because it extended credit to transit patrons based on credit worthiness. Standard credit administration techniques were used including day-to-day account supervision, routine billing procedures, dunning notices, and referrals to collection agencies. This demonstration also marked the first successful effort to record fares using on-board automated fare identification recorders in a general revenue service environment. Previous demonstrations of the same equipment were performed in special needs transit programs with unique clienteles.

Charge-A-Ride fare collection service was found to be quite expensive to provide. The lowest operating cost per trip charged was $18.98. Charge-A-Ride service was found to be technically feasible and was used to pay for more than 5,000 trips made by Haverhill bus patrons during the evaluation period. A number of mechanical problems with the card reading machines were encountered, suggesting that a more reliable technology must be developed to provide this service in a larger system.

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PREFACE

This document was prepared as part of the Service and Methods Demonstrations Progam sponsored by the Urban Mass Transportation Administration (UMTA), Office of Service and Methods Demonstrations. This report presents an evaluation of the Charge-A-Ride credit card fare post-payment demonstration in Haverhill, MA.

Cambridge Systematics conducted the evaluation of this demonstration project. Mr. Allen Marshall, Cambridge Systematics' project manager, had overall responsibility for the evaluation effort. Mr. Richard Lung was responsible for a large proportion of the data analysis and evaluation of the fare identification machines' performance and reliability. Ms. Carol Walb analyzed the marketing strategies employed to promote Charge-A-Ride and the effectiveness of the marketing activities in encouraging participation. Mr. Terry Atherton was CSI's principal responsible and helped in preparing this report and guiding evaluation activities.

Mr. Robert Casey of the Transportation Systems Center was involved in supervising Cambridge Systematics' development of the evaluation plan and approach and provided valuable suggestions and guidance throughout the evaluation of the demonstration. Mr. Stuart McKeown was the UMTA project manager for the Charge-A-Ride project.

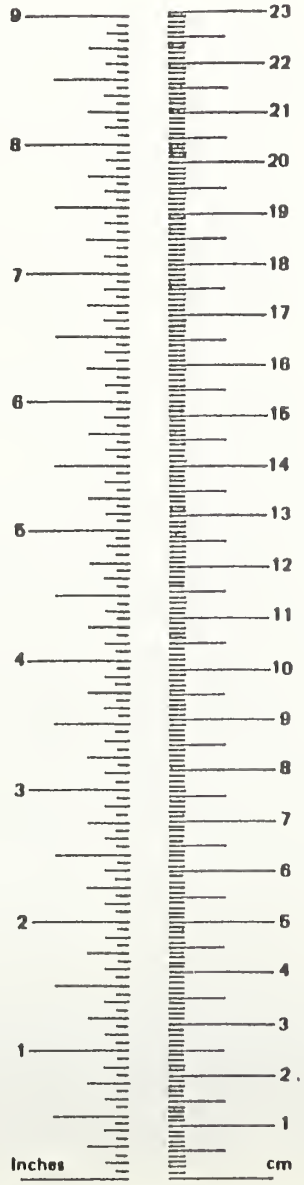
The Merrimack Valley Regional Transit Authority (MVRTA) was responsible for a number of data collection activities involved in the evaluation. Mr. Joseph Costanzo, the MVRTA administrator, provided his support to the project throughout the course of the demonstration. Ms. Xenia Z. Wong, the MVRTA local project manager, was particularly helpful in coordinating the transfer of information between the MVRTA and Cambridge Systematics and supporting data collection efforts. Ms. Wong also supplied a wealth of information related to management of the project. Ms. Shirley Hughes, technical manager and assistant to Ms. Wong, was instrumental in generating a microcomputer database of charge system usage and generating software for analyzing the records, as well as providing information crucial to analyzing the reliability of the fare recording machines.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in. = 2.54 cm (exactly). For other exact conversions and more detail tables see NBS Misc. Publ. 286, Units of Weight and Measures. Price $2.25 SD Catalog No. C13 10 286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	36	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

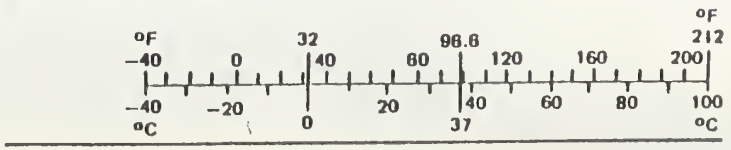


TABLE OF CONTENTS

		Page
1.	INTRODUCTION	1
	1.1 Background	1
	1.2 Project Objectives	3
	1.3 Evaluation Issues	5
	1.4 Evaluation Approach	7
	1.5 Demonstration Evaluation Responsibilities	8
	1.6 Organization of the Evaluation Report	9
2.	THE DEMONSTRATION PROJECT SETTING	11
	2.1 The Haverhill Area	11
	2.2 Demographic and Employment Profile	13
	2.3 Existing Transportation Services and Markets	19
3.	CHARGE-A-RIDE PROJECT DESCRIPTION	25
	3.1 Overview	25
	3.2 Service Area	25
	3.3 Project Financing	27
	3.4 Project Administration	28
	3.5 Implementation Schedule	31
	3.6 AFIR Machine Refurbishment and Reconfiguration	31
	3.7 Machine Performance	35
	3.8 Credit Administration and Billing	39
	3.9 Marketing Activities	48
4.	CHARGE-A-RIDE PROJECT PARTICIPATION	51
	4.1 Patterns of Charge-A-Ride Adoption	51
	4.2 Applicant Characteristics	56
	4.3 Patterns of Card Utilization	64
	4.4 Effectiveness of Charge-A-Ride Marketing Efforts	70
5.	CHARGE-A-RIDE COSTS AND REVENUES	73
	5.1 Overview	73
	5.2 Costs of Charge-A-Ride Service	74
	5.3 Revenue Losses	78
	5.4 Charge-A-Ride Revenues	78
6.	SUMMARY AND IMPLICATIONS FOR TRANSFERABILITY	81
	6.1 Overview	81
	6.2 Technical Success	82
	6.3 Public Acceptance of Charge Card Fare Payment	85
	6.4 Cost Effectiveness of Charge-A-Ride Service	87
	6.5 Implications for Transferability	88
APPENDIX I -	Comparison of Fare Payment Times for Charge-A-Ride and Other Payment Methods	I-1

LIST OF TABLES

Table

2.1 AGE-SEX DISTRIBUTION OF HAVERHILL AND SURROUNDING COMMUNITIES..... 15

2.2 LEVELS AND RANKS FOR HOUSEHOLDS MEDIAN INCOME IN MVRTA CITIES AND TOWNS..... 16

2.3 MAJOR EMPLOYERS, APPROXIMATE EMPLOYMENT AND NEAREST BUS ROUTE(S)..... 18

2.4 MVRTA COMMUNITIES AND SERVICES PROVIDED..... 21

2.5 RIDERSHIP BY RUN AND ROUTE AREA, AM PEAK HOURS OCTOBER 7, 1982..... 23

3.1 MARKETING EXPENDITURES BY CATEGORY..... 50

4.1 CHARGE-A-RIDE APPLICATION HISTORY SEPTEMBER 1983 TO DECEMBER 1984..... 52

4.2 AGE DISTRIBUTION OF CHARGE-A-RIDE CARD APPLICANTS BY ACCEPTANCE STATUS..... 59

4.3 MONTHLY INCOME OF CHARGE-A-RIDE APPLICANTS BY CARD APPROVAL STATUS..... 60

4.4 CARD APPLICANT EMPLOYMENT STATUS..... 61

4.5 DURATION OF TRANSIT SYSTEM USAGE FOR APPROVED CHARGE-A-RIDE APPLICANTS..... 62

4.6 FREQUENCY OF 1-WAY TRIPS ON MVRTA BUSES (DURING WEEK PRIOR TO SURVEY) FOR APPROVED CHARGE-A-RIDE APPLICANTS..... 63

4.7 USE OF OTHER MVRTA SERVICES FOR APPROVED CHARGE-A-RIDE APPLICANTS (MORE THAN ONE RESPONSE POSSIBLE)..... 63

4.8 CHARGE-A-RIDE TRIP AND TOTAL PASSENGERS BY MONTH ON MVRTA HAVERHILL ROUTES..... 67

4.9 CHARGE-A-RIDE USAGE BY CARD TYPE AND TIME PERIOD..... 69

5.1 ANNUAL OPERATING COSTS BY CATEGORY..... 75

5.2 CHARGE-A-RIDE MONTHLY COSTS: DESCRIPTIVE SUMMARY..... 76

I.1 COMPARISON OF FARE PAYMENT TIMES USING DIFFERENT METHODS..... I-3

LIST OF FIGURES

Figure

2.1 GEOGRAPHIC LOCATION OF THE DEMONSTRATION - HAVERHILL, MA..... 12

2.2 THE MVRTA REGION: PARTICIPATING COMMUNITIES..... 20

3.1 HAVERHILL BUS SYSTEM SHOWING DEMONSTRATION ROUTES..... 26

3.2 DETAILED BUDGET ALLOCATION..... 29

3.3 BUS DOOR VIEW OF A HAVERHILL AFIR..... 33

3.4 VIEW OF AN AFIR CARD READING MECHANISM IN USE..... 34

3.5 TOP VIEW OF AN AFIR SHOWING LOCATION RELATIVE TO EXISTING FAREBOX AND DRIVERS SEAT..... 35

3.6 CONTINUITY OF SERVICE DAYS BY MACHINE..... 38

3.7 HAVERHILL CHARGE-A-RIDE FARECARD APPLICATION FORM..... 40

3.8 MVRTA CHARGE-A-RIDE BILLING SYSTEM: DATA FLOW..... 46

3.9 AN ACTUAL MVRTA CHARGE-A-RIDE CARD, FRONT AND BACK VIEWS..... 47

4.1 CUMULATIVE APPLICATIONS: 9/83 - 12/84..... 55

4.2 ACCOUNTS AND CARDHOLDERS: 9/83 - 12/84..... 57

4.3 EXAMPLE DRIVER REVENUE SHEET..... 66

EXECUTIVE SUMMARY

In November 1983, the Merrimack Valley Regional Transportation Authority (MVRTA) instituted credit card service on its general revenue service buses within the city of Haverhill, Massachusetts as part of UMTA's Service and Methods Demonstration Program. This project was intended to demonstrate the viability of fare collection based on a credit card system (post-payment) in a regular transit service. The project was not intended as a demonstration of the technology of fare collection per se.

This evaluation covers the period of pre-implementation activities and the first year of the program's operation. It was MVRTA's judgment that a maximum participation level had been reached by December 1984. As a result, the MVRTA ceased accepting applications for the program soon after. The numbers presented in this document for credit card service usage cover the period from November 1983 to December 1984.

Project Participation--In the first year of the demonstration, a maximum of 71 credit accounts were active. These represented a potential usage pool of 116 persons. Only 16 applications were rejected for credit-based reasons during the course of the demonstration. The level of participation is relatively high considering the modest number of users of the Haverhill system (less than 400 trips per day).

Program marketing efforts were found to be modestly successful in attracting new applicants, although the on-board advertising methods were the single most effective means of promoting the service. More costly

methods were employed but were discontinued due to the high cost per application received.

It appears that although the Haverhill riding public was willing to participate in this program of fare post-payment, the modest number of participants does not enable another transit property to predict the potential levels of participation in this kind of project with any certainty.

Service Utilization--During the first month of the demonstration 111 trips were charged using the Charge-A-Ride cards. By late 1984 more than 500 trips per month were being charged. The majority of these trips were taken in peak periods. Of 5,452 trips, only 143 were weekend trips. It was concluded that regular bus riders, most likely using the system for work trips, were by far the largest users of this system.

Service Levels--The increasing charge usage reflects the success of the project staff in maintaining a reasonable level of service through the course of the demonstration. There were no interruptions in the card fare payment service during the course of the demonstration, although the automated fare recording equipment in each bus was not always operational for a variety of reasons. In those instances, fares were recorded manually.

Overall Feasibility Assessment--The concept of fare post-payment is technically feasible based on the Haverhill experience. The Charge-A-Ride program was successful in establishing a credit system as well as implementing automated collection of charged fares, in spite of the difficulties of using obsolete, malfunctioning equipment. However, the cost of providing the service was still significantly higher than the revenues gathered from charged trips.

With modern equipment less prone to failures and high maintenance needs, and a more fully developed and streamlined credit administration system, credit card fare postpayment might be dramatically less costly to provide. Nonetheless, it is clear from the experience of this project that the service can only be cost effective if a large number of charged fares are to be processed, thereby spreading the fixed costs associated with this fare collection procedure over a larger number of trips, which would lower the unit cost of collecting each fare down to a rate which is comparable with conventional fare collection methods. Otherwise, this method of fare collection cannot be considered a reasonable alternative for transit properties interested in innovative fare collection methods based on the results of this demonstration.

1. INTRODUCTION

1.1 BACKGROUND

A variety of experiments related to innovative transit fare collection methods have been carried out in numerous transit agencies of all sizes thoughout the United States as part of the Urban Mass Transportation Administration's (UMTA) Service and Methods Demonstration (SMD) program. In 1982, the Merrimack Valley Regional Transit Authority (MVRTA) submitted a grant proposal under this program for demonstration of credit card fare payment on their buses. This proposal was accepted and the demonstration was implemented in November 1983.

Although there has been previous experimentation with credit card fare payment methods, this demonstration was the first attempt to implement this fare collection technique in a general revenue service environment, rather than in a special needs transit service. Previous demonstrations of credit card fare collection were conducted in Naugatuck, CT and Portland, OR. In both of these demonstrations, problems occurred with the mechanical components of the charge card system which led to discontinuation of automated fare recording. The general concept of credit and fare post-payment, however, has been relatively well received in spite of these mechanical difficulties. The Portland and Naugatuck demonstrations suggested that this method of deferred payment showed some promise. The results of these two demonstrations are summarized below.

Naugatuck--The Naugatuck demonstration was primarily an elderly and handicapped demand-responsive transit demonstration which included fare post-payment as but one aspect. The fare billing system was designed to

perform two functions. Primarily, automated fare billing, or FAIRTRAN^{R} as it was known in Naugatuck, was to be used to compute passenger fares based on a combination of trip length, vehicle occupancy, time of day, group size, and other factors. The exact fare was not known to the passenger beforehand; rather, it was derived by computer software as part of the billing process. In addition to the flexible fare setting mechanism, the Naugatuck project was a test of the feasibility of automated on-board fare collection in general.

The machines employed are known as AFIRs, an acronym for Automatic Fare Identification Recorders. They are designed to perform automated card verification and charge recording by magnetically imprinting information such as account number, time, route, and date information for each charged fare.

A number of problems with the flexible fare setting concept and the automated billing system were encountered in Naugatuck. Briefly, these included the following:

- Because patrons were unable to determine their travel costs before hand due to the relatively high sensitivity of fares to variation in trip timing, vehicle occupancy, and trip patterns of other users, there was some resistance to the concept of flexible fares;
- The indeterminate prices of trips did not encourage efficient use of the service by patrons;
- The sum of fares computed from the formula did not necessarily match the hourly operating cost target for the vehicle, thus producing unexpected deficits (or profits) in revenues.

In addition, problems with the machines included cassette tape recording errors, improper operation by users and drivers, hardware failures, maintenance problems, and other difficulties. As a result of

these difficulties, the flexible fare concept was discontinued in June 1974, when fixed zone-based fares were established. The automated fare billing system was discontinued in June 1975, when simpler and more reliable manual methods of fare post-payment were introduced.

Portland--In Portland, the fare billing system was intended to provide an easy mechanism for social service agencies to subsidize clients with special transportation needs. The credit system was to generate monthly statements for each agency based on actual usage levels (charged trips) and to provide a variety of ridership information, such as passenger identification, date, time and mileage at boarding and alighting, and total travel time and mileage. In practice, the automated fare billing system never became fully operational for a number of hardware-related reasons. A combination of the "hostile" service environment and heavy electrical system demands for operating wheelchair lifts, bus kneelers, and the fareboxes themselves, led to poor machine performance. Hardware faults were found with the on/off switches and the interface mechanism between the on-board recorders and the fare billing system which analyzes and processes the data gathered by the recorders. In addition, the bus odometer was never linked to the recorders, thus preventing mileage recording.

1.2 PROJECT OBJECTIVES

Extension of the Automated Fare Billing to General Service--The two previous demonstrations in Naugatuck and Portland did not adequately demonstrate the feasibility of the fare post-payment concept or automated

fare recording and billing operations. Neither the machines nor the credit concept were tested with a clientele of regular bus passengers on regular route buses. Key questions which remained after reviewing the findings of previous demonstrations included:

- Is available hardware capable of operating reliably in any service environment?
- Is fare post-payment a viable means of fare collection with or without automated fare recording machines?
- What are the cost, revenue, ridership, and operational impacts of automated fare billing in a general revenue service environment?

Objectives of the Haverhill Demonstration--The major objectives defined by the MVRTA for this demonstration were to demonstrate the feasibility of automated billing and determine the level of public acceptance of the concept. This means trying to provide answers to the questions: How well does the AFIR system (and its related infrastructure) function; and, Who uses the system? Less important goals include determining whether useful ridership data can be generated from the credit records and the potential utility of the system for introducing innovative pricing and marketing strategies.

Thus, the areas of interest in this demonstration include:

- Performance evaluation of the automatic credit card payment technology in a general revenue service environment;
- Patron acceptance and use of charge fare payment;
- Possible management and adminstrative impacts of the fare collection technique, particularly, special or extraordinary costs associated with this payment method;
- Effects of the alternative fare payment method on transit operations, demand, ridership, and system revenues;

- Utility of the variety of ridership data collected as part of the charge recording mechanism.

The first two focus areas mentioned above represent the objectives identified in the MVRTA's grant proposal; the remaining areas evolved during the development of the evaluation plan.

While the issues of technological feasibility and consumer acceptance of the automated billing concept have been addressed in other demonstrations, the Haverhill Charge-A-Ride program provides the first opportunity to explore these issues under general revenue service conditions. In addition, it also provides an opportunity to assess the potential costs and revenues associated with this method of fare payment.

1.3 EVALUATION ISSUES

For the purposes of this evaluation, the analysis of potential impacts is organized into seven areas:

1. Demonstration Management Issues--This demonstration of the AFIR machines has required a significant amount of management time by MVRTA staff. As many as three employees have been involved in running this demonstration. The project manager has been involved in training staff, credit management, purchasing computer equipment and software, dealing with subcontractors, marketing and ensuring smooth running for the project. Management requirements and costs are of significant concern in this demonstration, because the problems encountered in a modest way in the Haverhill demonstration may be significant obstacles in a larger system.

2. Adoption of Service by Patrons--This evaluation employs charge applications and credit card usage data to determine the receptiveness of patrons to this concept. The characteristics of applicants are examined as part of this analysis. Measuring acceptance of this fare collection method is a highly important aspect of this demonstration with implications for the feasibility and tranferability of the concept.

3. Revenue Issues--Also of importance to MVRTA management is the effect of credit payment on revenues. Three major concerns are the possibility of cash flow problems and fraudulent use of the credit cards, as well as non-payment of debts, all of which may result in direct losses of income to the authority.

4. Costs of Credit Administration--The costs of administering the credit cards are likely to be quite significant and of particular interest to other properties considering this method of fare payment. It has already been suggested that there may be effects on overall system revenues due to the use of credit cards. The costs of administering the program under routine conditions may be sufficiently high as to generate unacceptable losses to the authority on each charged trip even if the other sources of potential loss are minor. This evaluation examines the costs of credit administration, particularly equipment, overhead, and labor costs. These can be separated into start-up costs which are incurred prior to the implementation of the actual service, and continuing costs which are relatively constant during the course of the demonstration. In turn, the costs of credit can be compared to conventional cash payment collection and administration costs.

5. Transit Demand and Ridership--A relatively minor concern in this demonstration is the effect of fare post-payment on the demand for transit. It is apparent that the MVRTA has relatively modest levels of ridership within Haverhill. A 1983 ridership survey suggests that current riders are regular users of transit, are primarily commuters, and are, in some cases, relatively new riders. Regular riders are ideal candidates for credit card payment and are the types of riders the Authority needs to increase system ridership levels in the long-term as well.

6. Transit Operations--The implementation of these machines on MVRTA buses has affected transit operations, particularly scheduling and bus allocation demands, and supervisory requirements in the field. Important general issues are the availability of the service to patrons on designated routes and effects on performance, such as diversion of buses due to breakdown, boarding delays, and patron or driver difficulties with the machines.

7. Equipment Performance Evaluation--The technical performance of the machines and the level of support needed to keep them operational, particularly installation and maintenance requirements, are minor concerns in this demonstration. While there have been significant time delays and costs associated

with installing and repairing the machines, the age and obsolescence the equipment used for this demonstration makes evaluation of their performance relatively unimportant in comparison with the other issues mentioned above. Equipment evaluation essentially consists of an assessment of overall service levels and determination of any possible impacts of the fare collection method on passenger boarding times (Appendix I).

1.4 EVALUATION APPROACH

To address the evaluation issues discussed previously, an evaluation plan was prepared in August 1983. This plan suggested several types of data collection activities, including:

- interviewing project personnel;
- collecting participant charge records on a regular basis;
- analyzing Charge-A-Ride credit applications;
- conducting user surveys at the time of application and during the course of the demonstration; and
- maintaining records on AFIR machine performance.

Each of these activities has helped develop a body of information about the Charge-A-Ride demonstration for this evaluation. This evaluation report focuses primarily on measuring public acceptance of the automated fare billing system, and assessing the cost of operating such a service, in comparison with revenues generated and normal system operating costs and revenues. Any secondary effects of the system on operations will also be determined where possible.

The characteristics of both users and non-users as well as the actual usage patterns of cardholders have been tracked throughout this demonstration and provide a means of assessing interest levels and the sustained

involvement of MVRTA riders in the program. Card applications have provided information on patron characteristics which may influence acceptance of the charge cards. Surveys have tested awareness of the program and attitudes towards the concept. The card usage records and monthly billing totals provide concrete evidence of public interest in the program i.e., the cards are used.

Project administration records provide insights into the costs of providing this service such as marketing, administrative labor and overhead, and maintenance costs. In addition to these operating costs, expenses have been tallied which are related directly to the technology. These include, in particular, the cost of refurbishing the AFIR units prior to the project's implementation. Revenues from the program are available directly from the project accounts receivable record.

Taken together, these evaluative analyses will assess the feasibility of fare post-payment in a general revenue service environment--in particular, the acceptability of the concept to patrons as well as the practical management and technological issues related to credit card fare post-payment.

1.5 DEMONSTRATION EVALUATION RESPONSIBILITIES

Cambridge Systematics (CSI) has had responsibility for monitoring and evaluating this project. The Transportation Systems Center (TSC) has provided technical supervision of the evaluation contractor. The evaluation of the project has required an integration of TSC's, CSI's, and MVRTA's roles throughout the demonstration. Basic responsibilities of CSI during this evaluation have included:

- developing data collection specifications;
- developing a schedule of evaluation tasks and data collection efforts;
- reviewing and monitoring data collection efforts for conformance to the Evaluation Plan;
- designing and performing the data analyses; and
- developing this evaluation report to assess the project's implementation, operation, impacts and achievement of stated objectives.

MVRTA has been responsible for providing much of the information and data necessary to perform the evaluation. In addition to providing documents related to operating procedures (e.g., progress reports, charge records, etc.), MVRTA responsibilities have included acting as a data collection coordinator/clearinghouse to:

- keep TSC and CSI informed of demonstration plans and activities;
- provide a chronology of project events;
- provide data and information on demonstration operations;
- conduct surveys of various types;
- obtain additional data if not otherwise available; and
- transmit data in a format agreed upon with CSI.

1.6 ORGANIZATION OF THE EVALUATION REPORT

Section 1 has presented an introduction to the Charge-A-Ride project and an overview of previous projects involving automated fare billing systems, as well as a summary of the evaluation issues and approach. Section 2 describes the project setting, including Haverhill's geographic location and demographic characteristics and the MVRTA, including its organizational structure, responsibilities and services offered.

Section 3 describes the Charge-A-Ride project including the MVRTA implementation activities, the final operating configuration for the service, problems encountered with the machines and the solutions developed, the administrative requirements necessary for operation of credit card fare post-payment, and the marketing strategies employed by the MVRTA to encourage card application and use. Section 4 assesses project participation by MVRTA patrons. Areas of concentration include: an analysis of card applicant characteristics; the patterns of card adoption; usage levels during the demonstration period; and the possible role and effectiveness of marketing efforts in encouraging project participation by Haverhill MVRTA riders.

Section 5 discusses the impacts of the service on operating costs and revenues. Section 6 presents a summary of the evaluation results and briefly discusses the implications of this project for the transferability of credit card fare post-payment to other properties. Appendix I presents an analysis of comparative boarding times for several different fare payment methods.

2. THE DEMONSTRATION PROJECT SETTING

The Charge-A-Ride project was implemented in Haverhill, Massachusetts, by the Merrimack Valley Regional Transit Authority (MVRTA). The operating agency, the Merrimack Valley Area Transportation Company (MVATC), a local subsidiary of ATE, provided in-kind support to the project during the course of the demonstration. This section discusses the setting of the project, including:

- geographic location,
- socioeconomic characteristics
- existing transportation services and transit markets

2.1 THE HAVERHILL AREA

Haverhill is located to the north and east of Boston along the Merrimack River. It is part of the Lawrence-Haverhill SMSA which incorporates towns in the northeast corner of the state as well as towns in southern New Hampshire. Haverhill is economically and functionally related to a larger metropolitan system because of its proximity to Boston (see Figure 2.1).

Haverhill is similar in outward appearance to a number of other cities in Massachusetts and New England. These are the former "mill towns" which were built upon an industrial base of textiles and other durable manufacturing activities. Unlike other New England mill towns such as Holyoke, Chicopee, Fall River, or New Bedford, Haverhill and other cities in northeastern Massachusetts have avoided the dramatic economic declines of recent years. This is due to several factors,

State Line

Major Highways

Commuter Rail

FIGURE 2.1 GEOGRAPHIC LOCATION OF THE DEMONSTRATION - HAVERHILL, MA

particularly the growth of high-tech manufacturing employment and effective local promotional efforts. High-tech industries in the area have partially replaced the loss of employment in the traditional activities, most notably textiles and footwear manufacturing, which have fled to other areas of the country and overseas in search of lower wage rates. Local promotions have succeeded in attracting the new high-tech businesses in part because of the well-trained labor force and because the area is near Boston, one of the major manpower and financing sources for these rapidly-expanding industries.

2.2 DEMOGRAPHIC AND EMPLOYMENT PROFILE

City Size, Population Characteristics--Haverhill is the second largest incorporated city within the SMSA, with a 1980 population of 46,865 persons. There was a minor gain in population (1.6 percent) between 1970 and 1980, making Haverhill one of the few cities recording a gain during the intercensal period.[1] Since 1980, the population of the Lawrence-Haverhill SMSA as a whole has recorded a slight rise from 281,981 to 283,491.[2]

Age Structure--In spite of the gain in overall population, a more detailed examination of the population characteristics of the city of Haverhill shows an aging population. The median age for the population as a whole is 31.5 years, 29.5 years for males, and 33.5 for females. More than one-third of the households (35 percent) have at least one person

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[1] Annual Planning Information Report, Fiscal Year 1983 Northeastern Massachusetts, Massachusetts Division of Employment Security, p. 9,.

[2] Calculated from population numbers in the above reference.

over 60, and 34 percent of the population is over 60 years of age. A recent survey of riders by the MVRTA showed that 78.5 percent of transit users were over 18, and 26.5 percent were over the age of 65.[1]

As may be expected, people of working age and the elderly form the main sources of potential participants in the demonstration. It is not known to what extent young people may be potential users of a credit card fare payment system. Table 2.1 shows age-sex distributions and median ages for Haverhill, Lawrence, the MVRTA towns and cities, and the state of Massachusetts for comparison.

Income Levels--Median incomes are variable in the MVRTA region as shown in Table 2.2. The 1980 census income statistics (based on 1979 incomes) showed a high value of $35,144 for households in Boxford, and a low median income of $11,980 in Lawrence households. Haverhill's median household income was $15,044 in 1980. Both Haverhill and Lawrence are below the Massachusetts median of $17,575.

The elderly are a major group of MVRTA riders. The elderly in Haverhill are, by and large, relatively low income households. In Haverhill, 26 percent of all households are composed of elderly individuals. However, 11 percent of elderly families are poor, defined here as having an income less than 125 percent of the 1979 poverty level.[1] (The 1979 poverty level was approximately $4,400 for a 2 person elderly household.) The low median income of Haverhill generally suggests that a number of the elderly not considered "impoverished" by the census may in fact have

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[1]MVRTA User Characteristics Study, Merrimack Valley Planning Commission, December 1982.

[1]Computed from Census numbers derived from summary Tape Files 1A and 3A.

TABLE 2.1 AGE-SEX DISTRIBUTION OF HAVERHILL AND SURROUNDING COMMUNITIES

Age Group	Haverhill				Lawrence			
	Male	%	Female	%	Male	%	Female	%
0-15	5,522	25.3%	5,419	21.6%	8,249	28.2%	7,883	23.3%
16-21	2,440	11.2%	2,590	10.3%	3,075	10.5%	3,346	9.9%
22-60	10,075	46.2%	11,054	44.1%	12,937	44.2%	14,544	43.0%
61-64	1,111	5.1%	1,348	5.4%	1,528	5.2%	1,940	5.7%
65 +	2,643	12.1%	4,663	18.6%	3,492	11.9%	6,101	18.0%
TOTAL	21,791	100.0%	25,074	100.0%	29,281	100.0%	33,814	100.0%

Age Group	MVRTA Region				Massachusetts			
	Male	%	Female	%	Male	%	Female	%
0-15	25,700	25.8%	26,174	22.7%	653,728	23.9%	623,719	20.7%
16-21	11,421	11.4%	11,465	9.9%	332,985	12.2%	340,137	11.3%
22-60	47,051	47.2%	53,415	46.3%	1,347,111	49.3%	1,435,719	47.8%
61-64	4,971	5.0%	6,033	5.2%	126,323	4.6%	151,061	5.0%
65 +	10,616	10.6%	18,185	15.8%	271,023	9.9%	455,508	15.2%
TOTAL	79,769	100.0%	115,274	100.0%	2,731,170	100.0%	3,006,144	100.0%

Source: 1980 Census First Count Tables (STFIA).

TABLE 2.2 LEVELS AND RANKS FOR HOUSEHOLDS MEDIAN INCOME IN MVRTA CITIES AND TOWNS

City/Towns	Median Income	Rank
Boxford	35,144	1
Andover	27,256	2
Groveland	22,575	3
North Andover	22,228	4
Newbury	21,036	5
Rowley	19,748	6
Methuen	18,946	7
Merrimack	18,226	8
HAVERHILL	15,044	9
Lawrence	11,980	10
MASSACHUSETTS	17,575	

SOURCE: U.S. Department of Commerce, Census Bureau, 1980 Census of Population and Housing, Sample Data, Third Count Tapes (STF3A), from tables prepared by the Massachusetts State Data Center, Amherst, MA.

incomes close to the cutoff line. It is possible that the relatively old population of Haverhill, combined with the low incomes, may be factors in this demonstration. While a recent ridership survey did not ask questions related to income, it did show a large number of riders without access to autos, along with a high proportion of elderly riders. Taking automobile ownership as a crude proxy for income level, it may tentatively be suggested that the ridership targeted in this demonstration has high numbers of both lower income and elderly riders. In turn, the acceptance of

credit usage by the elderly and the lower income riders may be quite different from that of riders not disadvantaged by income or age.

Employment Characteristics of Haverhill--The Lawrence-Haverhill area has not experienced quite the same degree of economic recession as other cities in Massachusetts and the nation. The most recent numbers available for this evaluation show a 4.4 percent unemployment rate in Haverhill in October 1984.[1] This rate is relatively modest, although the recent slowing of high technology industry growth rates may have local consequences at some point. The numbers suggest that unemployment in Haverhill is not a very serious problem. However, if unemployment was concentrated within the work force of certain major employers, and those laid-off employees contributed heavily to the Haverhill ridership, unemployment could be an issue in this demonstration to the extent that it reduces bus usage.

Major Employers in the Haverhill Area--Western Electric Corporation is a major local employer, employing 8000 or more persons. The MVRTA special peak hour employment service serves the Western Electric plant, and has a recorded ridership of 106 during AM peak hours, suggesting the importance of plant employees as bus patrons. Other major employers serviced by the MVRTA buses include Compugraphic, Allen Shoe, and others, many within the Ward Hill Industrial Park. Table 2.3 shows major employers, the approximate number of employees (not all of whom are potential bus riders, of course), and the associated bus route coverage. Work trips to major employers account for a large number of the riders within

[1]MVRPC information as of February, 1985.

Haverhill. Current economic conditions are relatively stable, but layoffs at one of the employers might have serious impacts on transit usage. For example, employment at Western Electric (now AT&T Technologies) is down from over 10,000 in 1982 to roughly 8,000 employees on all shifts in 1983.[1] Because employees are important transit users, MVRTA attempted to focus the marketing of the credit cards on certain major firms in the service area; both selling the credit cards as a potential employee benefit for management, and targeting its marketing efforts to employees.

TABLE 2.3 MAJOR EMPLOYERS, APPROXIMATE EMPLOYMENT AND NEAREST BUS ROUTE(S)

Employer	Number of Employees	Nearest Bus Route
Western Electric	8,000	ES
Compugraphic Corporation	600	ES
Allen Shoe Co., Inc.	350	01
LeSande Shoe Co., Inc.	250	16
Budd-Premier-Vernon Plastics	250	ES
Foss Manufacturing	240	ES
Rapid Processing	230	ES
Haverhill Paper Board Company	180	14
Savoy Leather	180	ES
Eastern Canvas Products, Inc.	150	15
Brentwood Furniture	130	15
Willian Ornsteen Heel Co., Inc.	100	14
Pope Machinery	85	21

Source: Merrimack Valley Regional Planning Commission, Industrial Survey, 1982.

[1]Phone conversation with Merrimack Valley Planning Commission.

2.3 EXISTING TRANSPORTATION SERVICES AND MARKETS

The Lawrence-Haverhill SMSA is well served by a number of transportation facilities including excellent interstate highway connections, Logan International airport in Boston, and commuter rail service provided by the Massachusetts Bay Transportation Authority (MBTA) and the Boston and Main railroad. Public transportation in Haverhill and surrounding areas is provided by the MVRTA which is responsible for the local bus routes which were included in this demonstration.

MVRTA Organization and Responsibilities--One of 13 regional transportation authorities in Massachusetts, the MVRTA is composed of ten member cities and towns in the northeast corner of the state (see Figures 2.1 and 2.2). It provides a variety of transit services pursuant to its charter as a "body politic and corporate and a political subdivision" of the Commonwealth of Massachusetts. Its general responsibilities under that charter include:

- provision of mass transportation service within its territory.
- Improving, modifying, and extending existing facilities.
- Raising money for transportation projects.
- Coordinating with outside transportation providers, e.g., the MBTA for commuter rail services.

The member towns are represented on an Advisory Board. Each town or city receives a weighted vote, based upon contribution to the operating funds and level of service. An Administrator, appointed by the Advisory Board, is responsible for the day-to-day operations of the authority, including this demonstration.

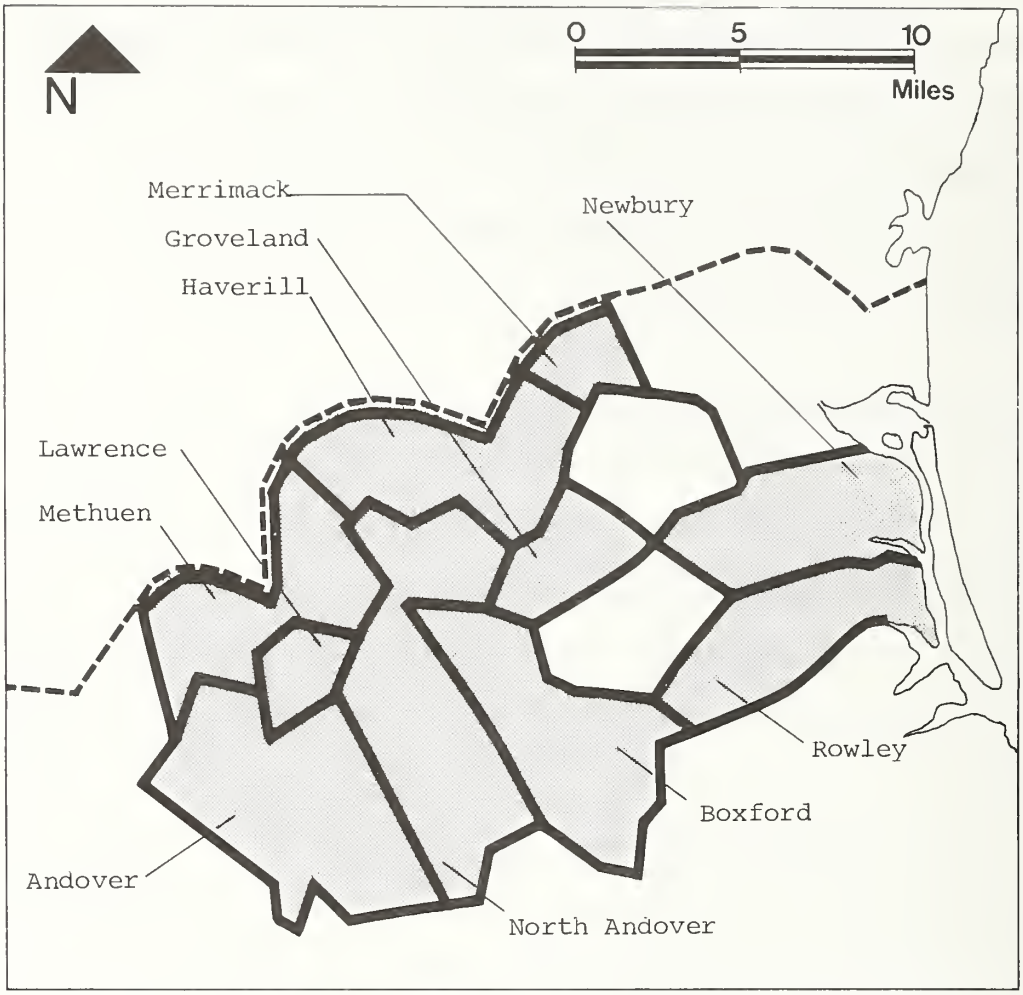


FIGURE 2.2 THE MVRTA REGION: PARTICIPATING COMMUNITIES

Services of the MVRTA--The MVRTA provides 4 types of service within its region. These are 1) a fixed route bus system; 2) elderly and handicapped services (24-hour notice); 3) a downtown shuttle in Lawrence; and 4) an agreement with the MBTA for provision of commuter rail to North Station in Boston (see Table 2.4).

MVRTA Service Area--At present, only 6 of the constituent cities and towns receive any transportation services from the MVRTA. Table 2.4 shows the towns receiving services and the services provided by the MVRTA.

TABLE 2.4 MVRTA COMMUNITIES AND SERVICES PROVIDED

City/Town	Services
Lawrence*	Fixed Route Bus Elderly/Handicapped
Haverhill*	Fixed Route Bus Accessible Buses
Andover*	Fixed Route Bus Elderly/Handicapped
North Andover	Fixed Route Bus Elderly/Handicapped
Methuen	Fixed Route Bus Elderly/Handicapped
Groveland	Fixed Route Bus

*MBTA Commuter Rail available to/from Boston.

MVRTA Transit Market--Within the MVRTA region, 2.54 percent (2,414/95,220) of the respondents to the 1980 census reported taking mass transportation of any kind to work. Ridership surveys on the fixed route buses show a system-wide AM peak ridership of approximately 1,500+, with 22 percent in Haverhill, 74 percent in Lawrence, and 6 percent on the intercity routes (see Table 2.5). The cities of Lawrence and Haverhill showed mass transportation usage rates of 3.78 percent (946/25,011) and 1.37 percent (276/20,146) respectively in the 1980 Census.

Facilities and Equipment--At present the authority owns and operates through its management company (MVATC) over 30 passenger buses, some of which were used for the demonstration. The authority also owns some small shuttle buses for use in downtown Lawrence. The Haverhill bus garage has recently been renovated and a new garage has been built adjacent to it, together providing modern facilities for maintenance, cleaning and storage of the bus fleet. The MVRTA main office is in downtown Haverhill. Nearby is a transit center which provides a collection and transfer point for commuter rail, intercity bus and local bus interline service in the city.

TABLE 2.5 RIDERSHIP BY RUN AND ROUTE AREA, AM PEAK HOURS
OCTOBER 7, 1982

Driver Run ID	Haverhill Routes	Number	Totals
R1A	Main St.	25	
	River St.	17	42
P1A	River St.	13	
	Main St.	21	34
R2A	Riverside	93	
	Hilldale	17	110
P2A	Riverside	9	
	Hilldale	24	33
R3A	Main St./Kenoza Ave.	60	
	Bradford	65	125
	Haverhill Total: 344		
	Percent: 22%		
	Intercity Route		
R4A	Haverhill - Lawrence		86
	Percent: 6%		
	Lawrence Routes		
R5A	Andover/Lawrence/North Andover		140
R6A	Andover/Lawrence/North Andover		87
R7A	Colonial Heights	133	
	Tower Hill	34	167
R8A	Pleasant Valley	125	125
R9A	Water Street	44	
	Prospect Hill	82	126
R10A	Lawrence St.	94	
	Beacon St.	129	223
P10A	Lawrence St.	16	
	Beacon St.	45	61
R11A	Town Farm		102
P11A	Town Farm		39
	Lawrence Total: 1,131		
	Percent: 72%		
	SYSTEM TOTAL 1,561		

Numbers obtained from Exhibit 2, MVRPC, MVRTA User Characteristics Study, December, 1982.

3. CHARGE-A-RIDE PROJECT DESCRIPTION

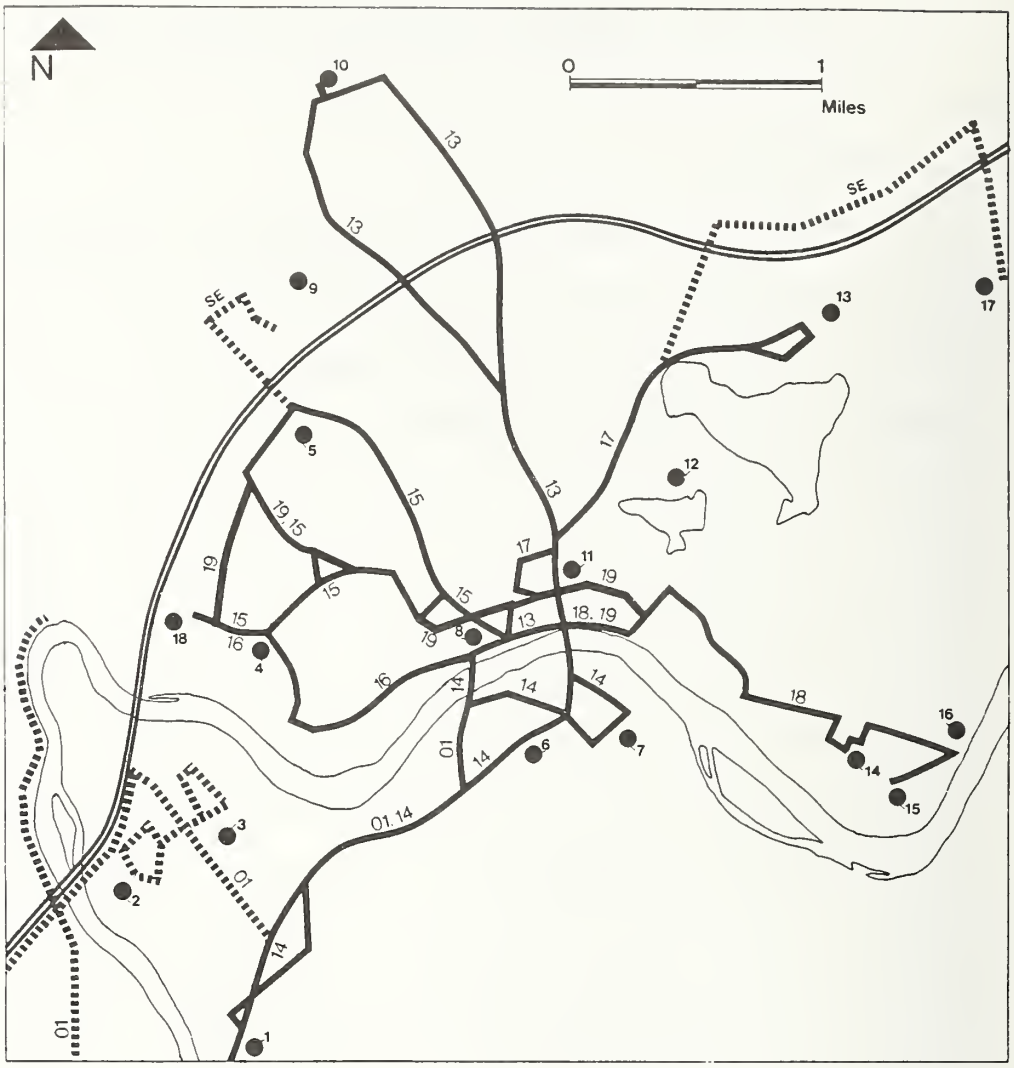
3.1 OVERVIEW

The MVRTA Charge-A-Ride project was intended to demonstrate the concept of automated fare billing in a general revenue service environment. As such, it differed from previous demonstrations which involved the use of automated fare collection equipment for special needs transportation services. The demonstration was also unique in that MVRTA granted cards directly to the patrons contingent on their credit standing, using relatively strict credit approval procedures. Individuals were then responsible for payment for the trips they took, rather than social service agencies as was the case in the Portland demonstration.

An additional aspect of this demonstration which is of some interest is the administrative organization of the project. Staff had to be hired to perform a wide range of administrative activities, including approving credit applications and preparing bills for customers. A number of other administrative procedures also had to be developed.

3.2 SERVICE AREA

Charge-A-Ride service was available on all the general revenue service bus routes in Haverhill and the Intercity Route to Lawrence via the State Line Mall for all hours of operation throughout the demonstration. No routes in Lawrence were included in the demonstration. The route map on the following page (Figure 3.1) shows the coverage geographically. Route 19 was added to the system in July 1983, and the layouts of existing



5 Major Trip Generators

1	Western Electric
2	Ward Hill - West Ind. Park
3	Ward Hill - East Ind. Park
4	Julian Steele
5	High School
6	Bradford College
7	Bradford Terrace
8	Washington Sq. Transit Station
9	Newark St. Industrial Park
10	State Line Plaza
11	City Hall
12	Winnekenni Park
13	Northern Essex Community College
14	Kennedy Circle
15	Haverhill Plaza
16	Groveland Center
17	Whittier Regional Vocational Technical High School
18	Westgate Area

14 Route Number and Name

13	Main St./North Ave.
14	Bradford/Ward Hill
15	Hilldale Ave./Westgate
16	River St./Westgate
17	Kenoza Ave./NECCO
18	Riverside/Groveland
19	Summer St./Westgate
01	Intercity Service
SE	Special Employment Service (Peak hours only)

FIGURE 3.1 HAVERHILL BUS SYSTEM SHOWING DEMONSTRATION ROUTES

routes were adjusted at that time. In addition to the regular fixed route services, a peak hour special employment service (ES) was operated with Charge-A-Ride services to employment centers including Western Electric. Charge privileges were not provided on any of the MVRTA special transit services such as WEEBUS or the summer-only beach bus. (This is in contrast to the Portland demonstration, where only special needs transit vehicles (LIFT) were equipped with the AFIR machines).

The Haverhill transit market area represents approximately 300-400 passenger trips per day. Some are handicapped and elderly persons, or students, but the majority are regular full-fare adult passengers. While the Lawrence transit area represents a significantly larger total market, the limited number of AFIR machines prevented operation of Charge-A-Ride there. Fifteen machines were available for use as part of this demonstration, nine of which were needed for operation on eight routes (the special employment service required two buses) at any given time. The remainder served as backup machines to ensure the greatest amount of uninterrupted coverage.

3.3 PROJECT FINANCING

The Charge-A-Ride project was funded as a Section 6 demonstration project under the UMTA Service and Methods Demonstration program. The grant application was approved by UMTA in Fall 1982 with an approved budget totaling $463,057, spread over two years. Project funding was split between federal resources of $416,557 and a local share of $46,500.

The initially approved breakdown of expenditures in functional categories is shown in Figure 3.2. (It should be noted that the expenditures for machine refurbishment were actually more than $80,000, not $40,000 as shown in budget code 554300 of the detailed budget in Figure 3.2.) The total of $10,000 for reimbursement of delinquent accounts (budget code 557400) was reduced and the funds reallocated to different expenditure areas.

3.4 PROJECT ADMINISTRATION

The Charge-A-Ride project was administered directly by the MVRTA. Direct responsibility for the operation of the demonstration was placed on staff hired specifically for the project. For most of the demonstration period, the project was administered by two full time employees--a project manager hired in January 1983 and a computer technician hired in August 1983, just prior to the expected September startup. A secretary was employed for routine office work for part of the project, but left the staff in the summer of 1984. The salaries of these employees were covered fully by the project grant. Other local staff contributed in-kind hours to the local share of the project costs. All levels of MVRTA employees participated, including the administrator of the authority. Employees of the Merrimack Valley Area Transit Company (MVATC), a local subsidiary of ATE, Inc., also contributed time. In particular, dispatchers, drivers, and mechanics were most heavily involved in the project. The mechanics performed routine machine maintenance. The drivers collected charge numbers when the machines were not working and reset the devices if

Budget CODE	DESCRIPTIONS	YEAR 1	YEAR 2	TOTAL
	Travel			
553000	Transportation (Project implementation and status briefings)	1,000	750	1,750
	Subtotal Travel	1,000	750	1,750
	Equipment			
554100	EDP Equipment			
	- Lease-back of 50 percent of in-house microcomputar	3,000	3,000	6,000
	- Video Terminal—workstation addition for billing	3,000	—	3,000
	- Cassatta play-back unit and interface	2,500	—	2,500
	- Printer: billing and collection notices	4,000	—	4,000
	Material end Equipment			
554200	- Encoded passas: encodad with account number end two-color print (10,000 @ $0.75)	7,500	—	7,500
	- Bulk tape eraser	300	—	300
	Subcontracts			
554300	- Inspection, rapair end rafurbishing of 17 AFIR units by SCOPE ELectronics, Inc. and mounting hardware	40,000	—	40,000
	Subtotel Equipment	60,300	3,000	63,300
	Personnel			
551300	Direct Labor—Clarical			
	- Secretary (full-time): general secretariel support, FILING AND MAINTAINING RECORDS	10,000	11,000	21,000
551400	Direct Labor—Managerial end Professional			
	- Project Manager (full-time)	22,000	24,200	46,200
	- Administretive Assistant (full-time): marketing, public relations, bookkeaping, and billing operations	15,000	16,500	31,500
	- Administrative Technicien (full-time): date entry, date file management, routine collection functions	13,000	14,300	27,300
551900	Direct Labor—Other			
	- Shop Mechanic (700 hours/year): installetion; equipment inspection, change-out, end repair	5,600	6,160	11,760
	- Road Mechanic (200 hours/year): field service end field change-out	1,300	1,430	2,730
	Subtotal Direct Labor:	66,900	73,590	140,490
	Fringe Benefits			
552000	Employee Benefits (45 percent)	30,105	33,116	63,221
	Subtotal Labor and Fringe	97,005	106,706	203,711

FIGURE 3.2 DETAILED BUDGET ALLOCATION

Budget CODE	DESCRIPTIONS	YEAR 1	YEAR 2	TOTAL
	Supplies			
554900	Miscellaneous Supplies			
	- Billing forms, stationary, printer ribbons	500	200	700
	- Data tape cassettes and eight-inch data disks	500	—	500
	Subtotal Supplies	1,000	200	1,200
	Contractual			
	Subcontracts-Consultant Services			
555200	- Local technical/management assistance contract used on an as-needed basis (@ $500/day)	25,000	20,000	45,000
	Subcontracts-Other Services			
555400	- Installation support by SCOPE Electronics	5,000	—	5,000
	- On-site and factory repair by SCOPE Electronics	5,000	12,500	17,500
	- Collection of delinquent accounts by collection agency	2,500	5,000	7,500
	- Marketing and promotion including preparation and distribution of promotional material	20,000	10,000	30,000
	Subcontracts-Other			
555600	- Accounts receivable and paysbls and mailing list software to support billing operations	1,500	—	1,500
	Subtotal Contractual	59,000	47,500	106,500
556100	Construction			
	Facility Rental			
	- Rental of furnished office facilities for project staff (750 sq. ft.)	5,000	7,500	12,500
	Subtotal Construction	5,000	7,500	12,500
	Other			
557100	Administrative Costs			
	- Management and Administrative: 10 percent of general office budget (administrator, assistant administrator, and office clerical) for project monitoring and budgeting	6,000	6,000	12,000
	- Allocation of cost of services provided by transit manager	5,000	5,000	10,000
	Other Project Costs			
557400	- Cost reimbursement for losses incurred through delinquent accounts and fraud	5,000	5,000	10,000
	Subtotal Other	16,000	16,000	32,000
	TOTAL DIRECT COSTS	239,305	181,656	420,961
	Contingencies (10%)	23,930	18,166	42,096
	TOTAL PROJECT EXPENSES	263,235	199,822	463,057
	LOCAL MATCHING SHARE	26,500	20,000	46,500
	TOTAL FEDERAL FUNDING	236,735	179,822	416,557

FIGURE 3.2 DETAILED BUDGET ALLOCATION (Con't.)

necessary. The MVATC dispatcher performed a coordinating role with the Charge-A-Ride staff.

3.5 IMPLEMENTATION SCHEDULE

The original grant for the Haverhill Charge-A-Ride demonstration was awarded in January 1983, with the expectation that service would begin in August 1983. The relatively large refurbishing requirements for the AFIR machines and ensuing delays in machine deliveries to the MVRTA necessitated postponements. In addition, the first set of charge cards ordered from Identi/Card did not operate properly and delayed the start of the project an additional month. Service on Haverhill buses began in early November 1983, three months after the expected August start up.

A marketing effort was conducted in September 1983, based on the assumption that the machines would be ready to go into service then. The additional delay to November meant that the initial marketing push for Charge-A-Ride program applications occurred before the service was actually available to patrons.

3.6 AFIR MACHINE REFURBISHMENT AND RECONFIGURATION

The Automatic Fare Identification Recorder (AFIR) machines used for the Haverhill demonstration were used previously in the Portland, OR demonstration, where they were found to be prone to failures for a variety of reasons. These problems had to be solved before the machines could be placed in a general revenue service environment in Haverhill. The MVRTA's ad hoc solution to faulty readers was to warm up the machines and the bus

approximately 15 minutes prior to scheduled service. The warm-up did not eliminate all problems, such as jamming due to accumulated debris in the mechanism, but did improve performance problems related to temperature.

In addition, the physical configuration of the machines was a potential source of implementation problems. In the Portland demonstration the machines were installed on small vans rather than regular buses, and the AFIR's were located directly on the dashboard. The dimensions of the original configuration used in Portland were approximately 10" H by 8" W by 12" L and the reading mechanism was enclosed in a single enclosure with the digital cassette recorder mechanism. For the Haverhill demonstration, the machines could not be located where they would interfere with the use of the regular bus farebox or the drivers' view of the curb. They also had to be installed for ease of use by boarding passengers.

The original AFIR machine manufacturer[1] was hired to make the machines operable for the MVRTA project and to develop a new machine enclosure and mounting system specifically for the Haverhill buses in order to solve the twin problems of hardware difficulties and incompatability of the Portland configuration with MVRTA bus installation limitations. Due to the variety of bus models in use on the Haverhill system, special mounting brackets had to be developed for the machines. Figure 3.3 shows a side view of a machine installed in a Haverhill bus. Note the bracket attachment, mounting platform, and top shield developed by the MVATC and its technical support contractor, KETRON, Inc.

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[1]Scope Electronics, Inc. of Reston, VA

FIGURE 3.3 BUS DOOR VIEW OF A HAVERHILL AFIR

The enclosure was also modified. The reading mechanism and its indicator lights were removed from the box and placed in a separate enclosure mounted on the hand rail used by patrons to climb the bus stairs. This required a two to three foot cable connecting the recorder box and the card reader. (See Figure 3.4) A blank cover plate with a

hole for the connector cable is located where the reader mechanism was mounted previously.

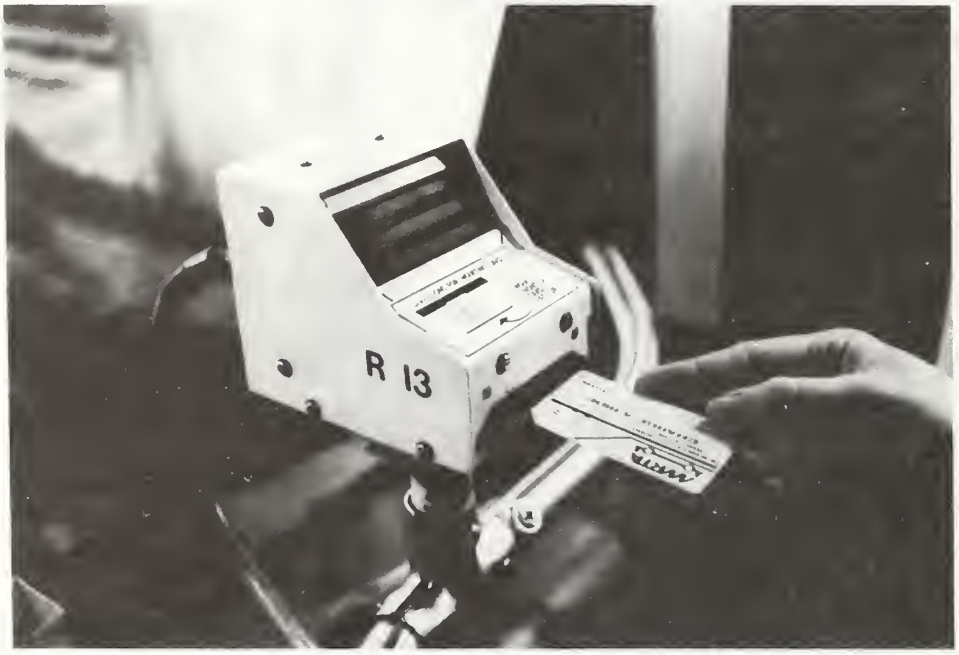


FIGURE 3.4 VIEW OF AN AFIR CARD READING MECHANISM IN USE

Figure 3.5 shows a top view of the reader, recorder, and connector cable as well as the farebox used for regular passengers. Minor adjustments were made to the mounting system when required for a particular bus. No subsequent modifications were made to the mounting setup.

Refurbishing Costs--The final cost of refurbishing 14 machines and developing the mounting apparatus was $82,565 or $5,900 per machine.

FIGURE 3.5 TOP VIEW OF AN AFIR SHOWING LOCATION RELATIVE TO EXISTING FAREBOX AND DRIVERS SEAT

3.7 MACHINE PERFORMANCE

During the course of the demonstration, a number of problems occurred with the on-board recording devices (AFIR). These problems were expected as the recording technology and the machines were outdated. Nevertheless, the MVRTA Charge-A-Ride project was able to provide continuous service throughout the demonstration period. Manual charge trip recording had to be used when there were machine failures, and servicing the machines consumed a noticeable amount of local in-kind support, but these extra efforts did result in uninterrrupted service. This level of service was not achieved in prior demonstrations of this technology.

Machine problems--During the course of the demonstration, several hundred reports were generated of machine problems of varying types and degrees of severity with respect to Charge-A-Ride operation. The vast majority of the problems were minor and transitory in nature. Few of the breakdowns were severe enough to impact the demonstration of automatic fare collection. The types of problems which occurred, both alone and in combination included:

- Clock errors
- Faulty signal lights
- Jammed read mechanisms
- Improper card reading
- Intermittent power problems
- Insufficient battery function
- Cold weather sluggishness
- Dirt and debris accumulation
- Faulty recording on tapes

Some of these problems were evident when the bus was in operation or being prepared for runs, and could be fixed or bypassed as needed. The problem of faulty recording was significant because the effects were not realized until the Charge-A-Ride staff tried to transfer the charge records from the on-board tape to the billing database. The recording errors led to missing or partial records which were difficult to recover and which formed a source of revenue losses.

Problem Solutions--Some of the mechanical problems were alleviated by turning the machines on for a time prior to the start of service. During cold weather, the entire bus was warmed up for 10 to 15 minutes prior to service to further ensure machine reliability. The warm-up period included a number of test card insertions to verify correct operation. These extra efforts to ensure reliability represented a commitment to providing uiniterrupted service by the MVRTA and its management company.

As discussed, recording errors were a potential source of revenue losses which might have hampered the demonstration's effectiveness and viability. The recording problems were recognized early and modifications were made to the billing software in an effort to overcome this problem. Parallel manual recording of charged trips helped isolate the problem and represented a double check on the AFIR-recorded trips.

Service Levels--The effectiveness of the various solutions and preventative measures is borne out by the fact that the Charge-A-Ride program was able to offer the service uninterrupted throughout the demonstration period. Figure 3.6 suggests that in any given month of the demonstration, adequate numbers of AFIR devices were in operation to cover the requirements of the Haverhill bus system. It is also clear that machines had to be swapped in and out of the buses in order to accomplish this level of service, but this necessity was well known in advance of the demonstration period, and was a primary reason for limiting Charge-A-Ride service to the Haverhill routes. There simply would not have been enough machines to equip both the Lawrence and Haverhill routes and maintain a reserve stock as well.

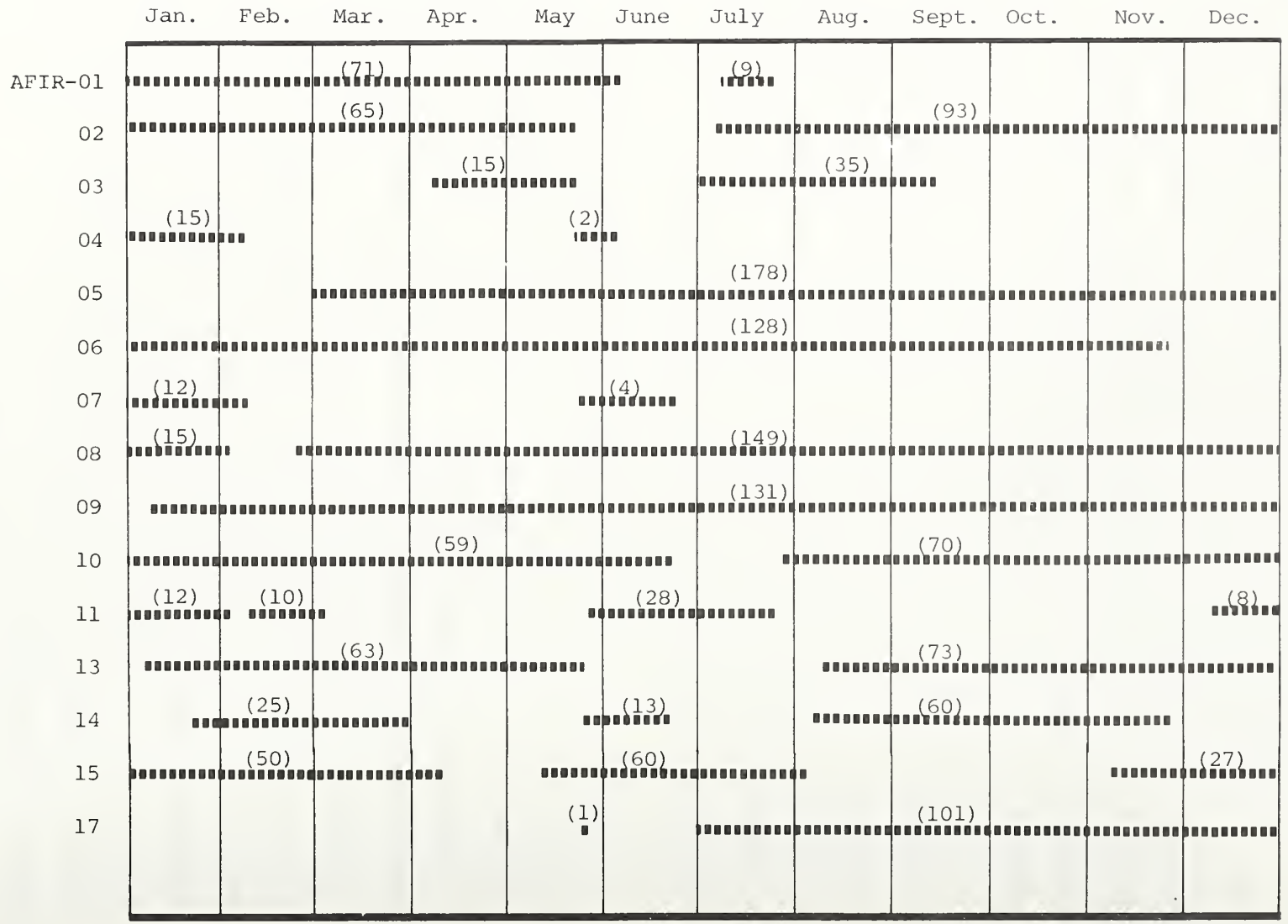


FIGURE 3.6 CONTINUITY OF SERVICE DAYS BY MACHINE

3.8 CREDIT ADMINISTRATION AND BILLING

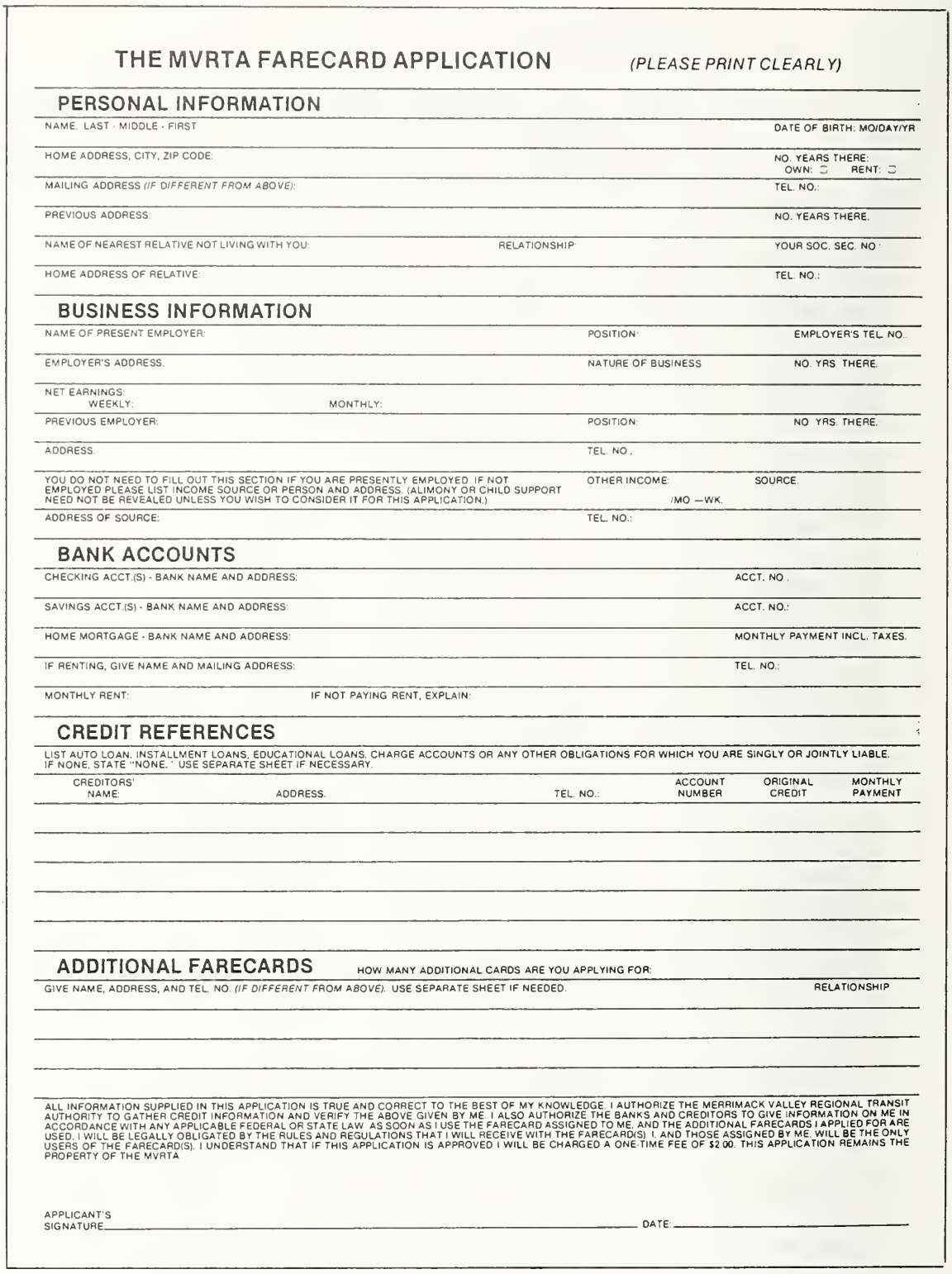
A unique aspect of this demonstration was the application of formal credit approval criteria to transit patrons. All applicants were screened for credit worthiness prior to receiving a Charge-A-Ride card. The administration of credit for transit fare payment imposed requirements on the project staff which were above and beyond those normally encountered by demonstration projects. The demonstration staff developed procedures for handling the following special project administrative requirements:

- Handling applications
- Establishing criteria for application approval
- Setting a billing schedule
- Establishing a payment and delinquency policy
- Determining methods for collecting overdue accounts
- Suspending credit privileges

Applications Procedure--Potential Charge-A-Ride users had to fill out a formal credit application prior to receiving a FARECARD. This form, shown in Figure 3.7, is almost identical functionally to the type of form used for a "regular" credit card application, e.g., a bank credit card.

Each applicant was charged a $2 fee for processing the information, which was applied to the cost of obtaining a flash credit check performed by a local credit bureau. As an incentive for applying early, the first fifty applicants did not have to pay this initial application fee.

Application forms were available at the MVRTA offices in downtown Haverhill, at the Haverhill transit center (where bus maps, schedules, and



THE MVRTA FARECARD APPLICATION

(PLEASE PRINT CLEARLY)

PERSONAL INFORMATION

NAME. LAST - MIDDLE - FIRST — DATE OF BIRTH: MO/DAY/YR

HOME ADDRESS, CITY, ZIP CODE: — NO. YEARS THERE: OWN: ☐ RENT: ☐

MAILING ADDRESS *(IF DIFFERENT FROM ABOVE)*: — TEL. NO.:

PREVIOUS ADDRESS: — NO. YEARS THERE.

NAME OF NEAREST RELATIVE NOT LIVING WITH YOU: — RELATIONSHIP: — YOUR SOC. SEC. NO.:

HOME ADDRESS OF RELATIVE: — TEL. NO.:

BUSINESS INFORMATION

NAME OF PRESENT EMPLOYER: — POSITION: — EMPLOYER'S TEL. NO.:

EMPLOYER'S ADDRESS. — NATURE OF BUSINESS — NO. YRS. THERE.

NET EARNINGS: WEEKLY: — MONTHLY:

PREVIOUS EMPLOYER: — POSITION: — NO. YRS. THERE.

ADDRESS. — TEL. NO.:

YOU DO NOT NEED TO FILL OUT THIS SECTION IF YOU ARE PRESENTLY EMPLOYED. IF NOT EMPLOYED PLEASE LIST INCOME SOURCE OR PERSON AND ADDRESS. (ALIMONY OR CHILD SUPPORT NEED NOT BE REVEALED UNLESS YOU WISH TO CONSIDER IT FOR THIS APPLICATION.) — OTHER INCOME: /MO —WK. — SOURCE.

ADDRESS OF SOURCE: — TEL. NO.:

BANK ACCOUNTS

CHECKING ACCT.(S) - BANK NAME AND ADDRESS: — ACCT. NO.:

SAVINGS ACCT.(S) - BANK NAME AND ADDRESS: — ACCT. NO.:

HOME MORTGAGE - BANK NAME AND ADDRESS: — MONTHLY PAYMENT INCL. TAXES.

IF RENTING, GIVE NAME AND MAILING ADDRESS: — TEL. NO.:

MONTHLY RENT: — IF NOT PAYING RENT, EXPLAIN:

CREDIT REFERENCES

LIST AUTO LOAN, INSTALLMENT LOANS, EDUCATIONAL LOANS, CHARGE ACCOUNTS OR ANY OTHER OBLIGATIONS FOR WHICH YOU ARE SINGLY OR JOINTLY LIABLE. IF NONE, STATE "NONE." USE SEPARATE SHEET IF NECESSARY.

CREDITORS' NAME:	ADDRESS.	TEL. NO.:	ACCOUNT NUMBER	ORIGINAL CREDIT	MONTHLY PAYMENT

ADDITIONAL FARECARDS

HOW MANY ADDITIONAL CARDS ARE YOU APPLYING FOR:

GIVE NAME, ADDRESS, AND TEL. NO. *(IF DIFFERENT FROM ABOVE)*. USE SEPARATE SHEET IF NEEDED. — RELATIONSHIP

ALL INFORMATION SUPPLIED IN THIS APPLICATION IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE. I AUTHORIZE THE MERRIMACK VALLEY REGIONAL TRANSIT AUTHORITY TO GATHER CREDIT INFORMATION AND VERIFY THE ABOVE GIVEN BY ME. I ALSO AUTHORIZE THE BANKS AND CREDITORS TO GIVE INFORMATION ON ME IN ACCORDANCE WITH ANY APPLICABLE FEDERAL OR STATE LAW. AS SOON AS I USE THE FARECARD ASSIGNED TO ME, AND THE ADDITIONAL FARECARDS I APPLIED FOR ARE USED, I WILL BE LEGALLY OBLIGATED BY THE RULES AND REGULATIONS THAT I WILL RECEIVE WITH THE FARECARD(S). I, AND THOSE ASSIGNED BY ME, WILL BE THE ONLY USERS OF THE FARECARD(S). I UNDERSTAND THAT IF THIS APPLICATION IS APPROVED I WILL BE CHARGED A ONE-TIME FEE OF $2.00. THIS APPLICATION REMAINS THE PROPERTY OF THE MVRTA

APPLICANT'S SIGNATURE _____ DATE: _____

FIGURE 3.7 HAVERHILL CHARGE-A-RIDE FARECARD APPLICATION FORM

other transit information are available), and on all the MVRTA buses. The form was included as part of the Charge-A-Ride brochure.

Criteria For Credit Approval--In most cases, a credit bureau was asked to perform a flash check on each application, to determine the known credit rating of the individual based on their other credit cards. Based on the credit bureau report, the MVRTA could make a decision to approve or reject the application. In several cases, persons with a poor (or non-existent) credit rating were issued cards at the discretion of the project manager who felt exceptions to the strict criteria should be made because Charge-A-Ride is a public service.

Billing Schedule--In Haverhill, bills were prepared during the first days of each month and mailed out immediately. Due to the relatively modest number of active accounts, all accounts were processed at the same time rather then staggered throughout the month. If more accounts had been active, it is possible that different billing schedules might have been needed.

Payment and delinquency policy--Within any credit system, a number of accounts can be expected to either pay late or go delinquent during any given month. This payment tracking capability was included in the billing software to target overdue accounts. Based on the number of days overdue, the account was either considered past due or delinquent. An account was considered overdue if payment was not received 30 days after the billing date, and a reminder or dunning notice was then sent. Any account more than 60 days past due was considered delinquent, and charging privileges

were suspended until payment was received. A letter was sent to the party instructing them to discontinue use of the card. Accounts more than 90 days past due were referred to a local collection agency.

Credit privilege suspension--The final recourse of the MVRTA for controlling unauthorized FARECARD use was termination of the delinquent accounts. This was done by determining the route on which the bulk of the bad charges were made by a particular delinquent account and turning off the AFIR machine for that route. Each user then had to present the card to make a charged trip. The driver compared the account number with the list of bad card accounts and seized the card if it matched. This procedure worked quite satisfactorily when utilized during the demonstration. This forcible suspension of privileges was accompanied by a formal notice of credit privilege suspension which was mailed to the account holder. Follow-up phone calls were also made to notify the card holder of suspension.

In addition, obviously delinquent accounts were not mailed renewal cards automatically at the end of each 6 month period. Inserting an expired card (identified by the check digit punched on it) in the AFIR unit generated a tone signal to the driver, who could then examine the card and possibly sieze it immediately.

At the option of the project manager, charge privileges could be reextended to delinquent accounts that paid the balance due.

Billing System Computer Hardware--The hardware purchased for this project included a full IBM microcomputer system for processing the charge

records collected with the AFIR machines on the bus. The system included the following components:

- IBM-PC with monochrome monitor and two disk drives
- Random Access Memory Expansion Card
- Printer
- Tape cassette reader/recorder unit for transferring charge records from on-board tapes

The total cost of this personal computer system with cassette read/write unit was close to $8,000. The Charge-A-Ride program leased the system from the MVRTA which actually purchased it. Since the demonstration ended, the MVRTA is using the system for a number of other administrative purposes unrelated to the Charge-A-Ride program.

Billing System Software Development--In the initial planning phase of the project, the MVRTA planned to purchase a commercially available accounts receivable software package to process the charge records generated with the AFIR machines, based upon the recommendations of MITRE Corporation. A total of 10 vendors were contacted regarding specification of available accounting software. The criteria used for evaluating the software packages included (as specified by MITRE):

- Hardware Requirements--"Shall operate on a 64K IBM PC computer with two disk drives and a 132 column dot matrix (or letter quality) printer."
- Data Entry Modes--"Shall accept both keyboard entered data and data from a front-end program (perhaps via data files)."
- Account Capacity "Shall handle up to 2,000 accounts. Shall handle up to 5000 transactions per month distributed across the accounts with a maximum for any particular account of 75 transactions."

- Reporting Capabilities "Shall print monthly bills containing
  - -- all transactions
  - -- previous balance
  - -- amount due
  - -- payment due date
  - -- payment overdue notice related to age of account delinquency
  - -- general message to be entered by an operator."

- Data Base Management "Shall allow read-only access by other programs to the accounts receivable data files for the generation of statistical reports."

None of the firms solicited were able to provide software which fulfilled these requirements, largely because their products were not geared towards managing the multiple transactions characteristic of transit fare post-payment.

As a result, the software for the MVRTA fare billing system was developed on a custom basis for this project by MITRE. MITRE was involved in the previous demonstration of the AFIR machines in Portland and had been retained by UMTA as a technical resource available to the Charge-A-Ride project at no cost. As a result, the original budget allocation of $1,500 for billing software was not expended and the grant money was allocated to other cost areas. The software was developed using both the BASIC language and dBase II, a popular database management package. Software development began in April of 1983 and a workable prototype was available coincident with the inauguration of Charge-A-Ride service in November. The system was fully operable for preparing that month's bills and has been used with only minor alterations since. Enhancements to the basic system, including a ridership tallying system, were developed by KETRON, Inc. under contract to the MVRTA.

Billing System Organization--The flow of Charge-A-Ride data through the fare billing system is shown schematically in Figure 3.8. The main processes involved in the management of fare records are:

- Reading on-board cassettes to retrieve charge records, and storing the information on floppy diskettes
- Posting daily trips by account to a monthly data disk
- Posting transactions (payments) to a monthly data disk
- Issuing farecards to applicants on a chronic basis
- Printing monthly statements

Credit Card Procurement--The credit cards used in the AFIR devices were manufactured to strict specifications for all dimensions including thickness, as well as the placement of punched holes for card number encryption. The cards do not operate using magnetic strips; rather, they are analogous to conventional computer punched cards. An actual MVRTA farecard is shown in Figure 3.9.

The MVRTA issued a Request for Quotations for the card procurement in May 1983 to seven possible manufacturers, four of whom were Massachusetts firms. The initial quotation specifications were for 5,000 cards to be delivered in August 1983 in anticipation of a September service start up. Based on a lowest bid criteria, Identi/Card, Inc. of Lancaster, Pennsylvania was selected to make the initial set of Charge-A-Ride cards. The total cost for the 5,000 credit cards was $1,202, or about 24¢ each.

The manufacturer delivered 5,000 cards in September 1983. Cards from the initial shipment were found to be inoperable with the AFIR units because of poor conformation to thickness tolerance and mis-punching of account codes and check digits (used for validity testing on-board). In

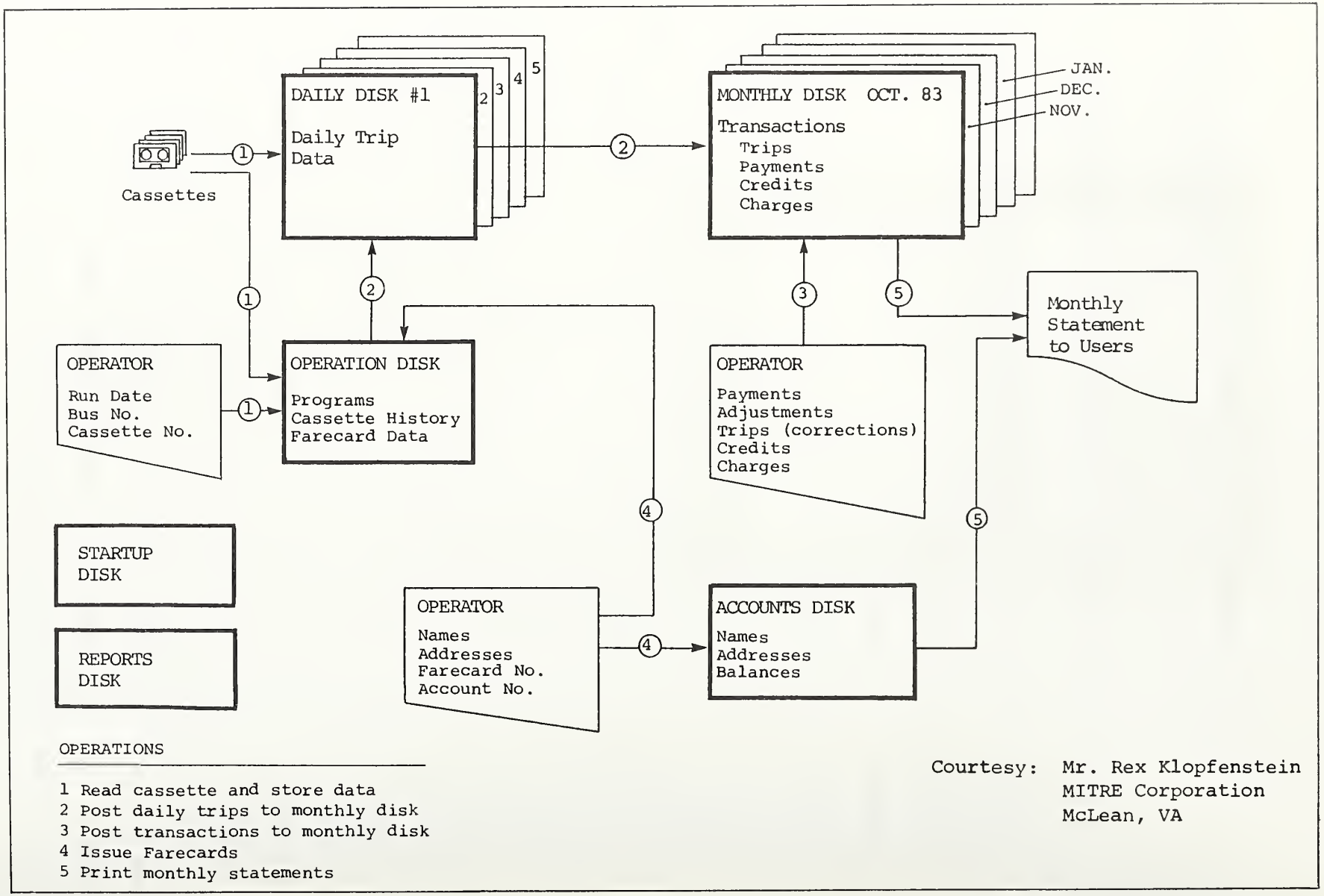


FIGURE 3.8 MVRTA CHARGE-A-RIDE BILLING SYSTEM: DATA FLOW

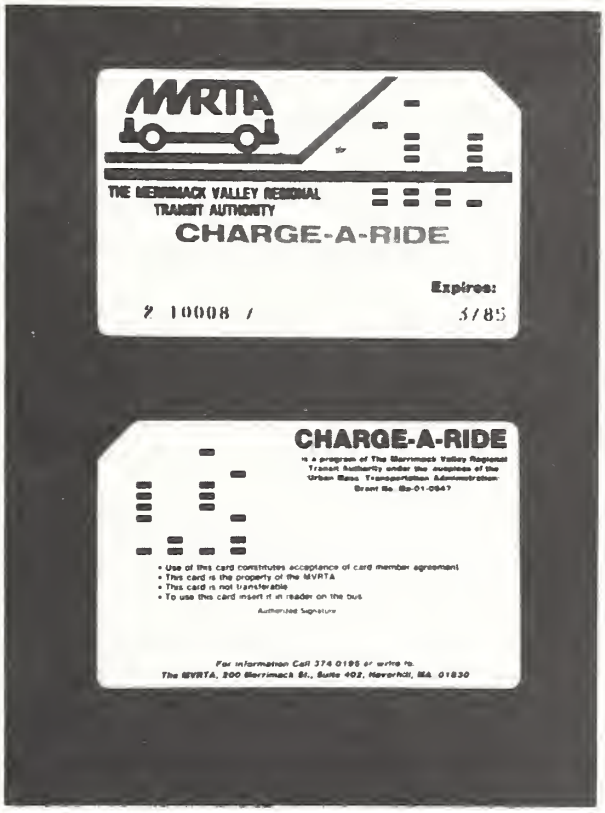

MVRTA
THE MERRIMACK VALLEY REGIONAL TRANSIT AUTHORITY
CHARGE-A-RIDE
Expires:
2 10008 /
5/85
CHARGE-A-RIDE
• Use of this card constitutes acceptance of card member agreement
• This card is the property of the MVRTA
• This card is not transferable
• To use this card insert it in reader on the bus
Authorized Signature

FIGURE 3.9 AN ACTUAL MVRTA CHARGE-A-RIDE CARD, FRONT AND BACK VIEWS

order to supply cards to users, MVRTA staff were forced to measure each of the cards for thickness and test each card repeatedly to verify the account number and check digit validity. This was a fairly time-consuming process. The initial cards actually used in the first six months of the demonstration were not laminated with plastic to protect the surface from abrasion, and particles of paint and ink chipping from the surface contributed to jamming problems with the on-board reader mechanisms. This problem was corrected in subsequent card purchases by specifying that a lamination was to be applied to each card during manufacture.

3.9 MARKETING ACTIVITIES

MVRTA took a traditional approach to marketing the Charge-A-Ride program. Marketing activities did not begin until after the project planning stage was completed and were almost exclusively confined to advertising. Selection of the service area was dictated by the limited number of card reader machines available and MVRTA's desire to provide full coverage on a limited number of routes.

In keeping with the demonstration's objective of attracting existing riders to the Charge-A-Ride program, marketing efforts were aimed at the 300-400 daily riders of MVRTA's Haverhill routes, and a market penetration goal of 20 percent was established. The demonstration grant included $30,000 for marketing. Due to limited staff resources, MVRTA decided to contract with an advertising agency for marketing support. A Request for Proposal was prepared by MVRTA's project manager and mailed out on March 25, 1983, to 11 local advertising firms. Proposals were received on April 13, 1983 from three firms, and the same advertising firm used by MVRTA for its other advertising requirements was selected.

Pre-implementation marketing activities began in July 1983, when the advertising agency conducted a media analysis and prepared brochures, bus cards, and advertising copy. Based on the media analysis, MVRTA decided to use a local radio station and newspaper to advertise the Charge-A-Ride program. Television was eliminated as being too expensive and ineffective. MVRTA began to actively market the Charge-A-Ride program in September 1983, one month prior to planned implementation. A radio jingle was produced by the advertising agency and played on a local radio station ten

times a day, three days a week. In addition, newspaper advertisements were run three times per week during this period. Brochures and bus cards were also prepared by the advertising agency for distribution on MVRTA vehicles. MVRTA also conducted an on-board survey during this period to identify employers for future target marketing. No direct mail, promotions, or other marketing activities were conducted either prior to or after project implementa- tion.

After implementation, MVRTA continued to market the Charge-A-Ride program with bus cards and periodic newspaper and radio advertisements. MVRTA contacted the employers identified in the on-board survey and asked for their support in marketing the Charge-A-Card program to employees. All employers indicated that they had ample free employee parking and were not interested. In addition, many employers had high rates of labor force turnover which they felt were not conducive to issuing the cards.

With the exception of bus cards, marketing activities, i.e., advertising, were suspended in March 1984, due to the high cost per application. MVRTA had been spending a monthly average of $1,800 for advertising while receiving only 5 to 6 applications. Marketing expenditures totalled approximately $19,050 through February 1984. The distribution of these expenditures is presented in Table 3.1.

TABLE 3.1 MARKETING EXPENDITURES BY CATEGORY

Posters	$ 850
Applications	795
Radio jingle production	5,000
Radio advertising time charges	2,841
Decals	263
Newspaper (production and space charges)	6,540
Flyers	1,211
Advertising firm administrative time	1,550
	$19,050

4. CHARGE-A-RIDE PROJECT PARTICIPATION

This section describes the participation of Haverhill-area bus patrons in the Charge-A-Ride program. The history of applications to the program is summarized in Section 4.1, including the total number of applications by month and their disposition (i.e., approved, denied, incomplete). Section 4.2 describes these applicants in terms of income, age, employment characteristics and transit usage and dependence. The next section describes the patterns of card utilization during the demonstration along several dimensions, including total trips by type of user and by time of day. The final section discusses the effectiveness of the Charge-A-Ride marketing efforts during the demonstration in terms of applications received and total card usage.

4.1 PATTERNS OF CHARGE-A-RIDE SERVICE ADOPTION

A well-developed body of literature exists on the adoption of innovations. This includes technical innovations, such as improved farming methods, organizational innovations, such as quality circles in work places, and new services, such as bank credit cards or as in this case, transit fare credit cards. A generalized representation of the patterns that have been observed in the adoption of innovations is given by the frequency distribution of adoption over time presented in Table 4.1. Innovation adoption situations typically display two main periods of interest: an initial flurry of applications in the first few months of the project, which was followed by a period with a declining rate of new applications.

TABLE 4.1 CHARGE-A-RIDE APPLICATION HISTORY SEPTEMBER 1983 TO DECEMBER 1984

Project Month	Applications Increment	Applications Cumulative*	Accounts Approved Increment	Accounts Approved Cumulative	Passengers Involved Increment	Passengers Involved Cumulative	Applications Denied Increment	Applications Denied Cumulative
September 83	1	1	0	0	0	0	1	1
October 83	18	19	13	13	21	21	3	4
November 83	19	38	11	24	17	38	6	10
December 83	6	44	4	28	11	49	0	10
January 84	13	57	8	36	12	61	1	11
February 84	6	63	2	38	2	63	2	13
March 84	8	71	4	42	8	71	0	13
April 84	2	73	2	44	4	75	0	13
May 84	3	76	0	44	0	75	1	14
June 84	3	79	2	46	2	77	0	14
July 84	6	85	6	52	9	86	0	14
August 84	7	92	5	57	10	96	1	15
September 84	7	99	7	64	11	107	0	15
October 84	1	100	1	65	1	108	0	15
November 84	1	101	1	66	1	109	0	15
December 84	6	107	5	71	6	115	1	16

* Of 107 applications received, 87 were complete, 4 were incomplete, and 16 applicants were denied cards because they lived outside the service area.

The applications history of the Charge-A-Ride project is a simple example of the general pattern of innovation adoption. The two periods of initial intense interest and subsequent decline in applications during the waning of the project are demonstrated in this section.

The data used to describe adoption patterns are copies of actual Charge-A-Ride program applications (stripped of identifiers for confidentiality). Each application was logged by date and approved status, and certain variables were extracted from the form such as age, income, residence, employment status, and number of passengers represented in each account (i.e., cards needed). The number of applications by month and status, as well as total cardholders are shown in Table 4.1. (Applicant characteristics are discussed in a subsequent section.)

The first Charge-A-Ride card application was received on September 15, 1983, and 18 additional applications were made during the month of October. Of these 19 applications, 13 were approved. (The criteria used for extending credit have been discussed previously in Section 3.) During the month of November, 19 more forms were received and 11 more accounts were approved. By the end of the first month of operation, there were 24 active accounts, representing a total passenger pool of 38 persons (more than one card can be issued to an account).

By the end of January 1984, there were 36 accounts and 62 cardholders. At the end of May 1984, after six full months of Charge-A-Ride service on Haverhill buses, a total of 76 applications had been received with 44 accounts approved, 28 denied, and 4 incomplete. A total of 75 passengers were involved in the Charge-A-Ride service.

By December 1984, after 13 months of Charge-A-Ride service, 71 total accounts were active, representing 115 passengers. Of 107 applications, a total of 16 applicants had been refused credit. The Charge-A-Ride program stopped accepting applications at the end of January 1985.

Denial of applications was not solely due to credit criteria. In addition to the 16 accounts denied for credit reasons during the evaluation period, 16 applications were received from individuals living in towns not served by the Haverhill bus system, particularly Lawrence and Methuen. These individuals would not have been able to take advantage of the Charge-A-Ride program on their local routes, and they were denied a card based on their home location. It should be noted, that 4 individuals were issued Charge-A-Ride cards but did not (apparently) live in the service area, according to their credit applications. This was because they worked in Haverhill.

Figure 4.1 shows the cumulative number of applications received by month during the course of the demonstration, based on Table 4.1. After the inital flurry of applications, a maximum of 8 were received in any month from February 1984 to the close of applications in January 1985. Overall, the adoption pattern for Charge-A-Ride service appears to be consistent with the idealized pattern of adoption discussed earlier. There is a period of initial interest followed by a decline in the application rate. The dip in applications in December 1983 may well be due to the difficulties encountered with the machines in the early phase of the demonstration, or it may be related simply to the holiday period. Aside from this month, the graph shows the expected pattern of application, in

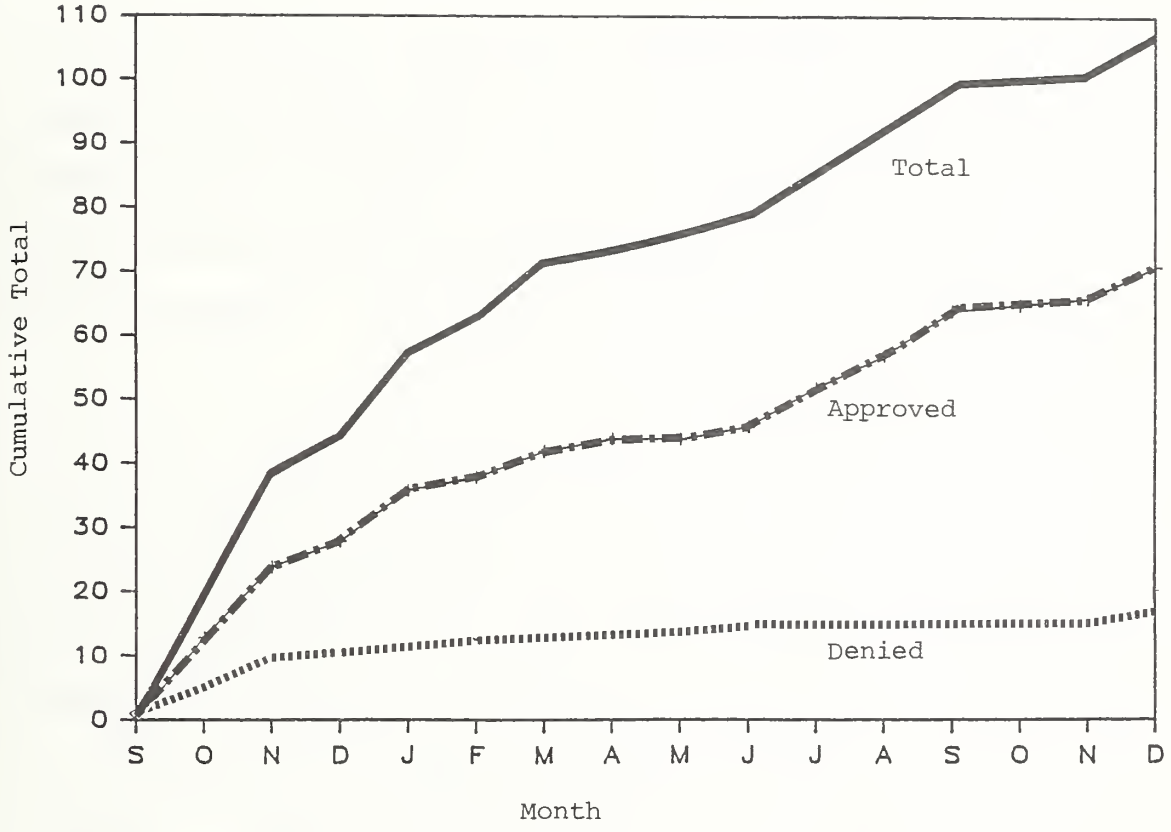


FIGURE 4.1 CUMULATIVE APPLICATIONS: 9/83 - 12/84

spite of the modest number of applications in any month. The number of approved accounts and the total number of cardholders belonging to the accounts are displayed in Table 4.1 and shown graphically in Figure 4.2.

4.2 APPLICANT CHARACTERISTICS

In the context of adoption theory, socioeconomic characteristics are indicators of an individual's propensity to adopt an innovation. Factors such as age, income, and employment status can influence individual decisions such as whether or not to apply for credit. (Communication factors are also involved.)

This section examines the pool of 107 Charge-A-Ride applicants and 50 application survey respondents in terms of age, sex, income, employment status and type, as well as transit use patterns. Where possible, the accepted and denied applicants are characterized separately and together. Within the application survey respondents, only accepted applicants are tabulated. In addition, these overall characteristics are compared with those of the general MVRTA ridership, using the results of a comprehensive ridership study conducted by the Merrimack Valley Planning Commission (MVPC) in 1982. Where comparable data do not exist in the 1982 ridership study (e.g., income data), card applicants are compared with Census data for Haverhill.

The analysis of applicant characteristics is based on the credit card application form and a short survey administered at the time of application by the MVRTA staff. (The application form used by the MVRTA for

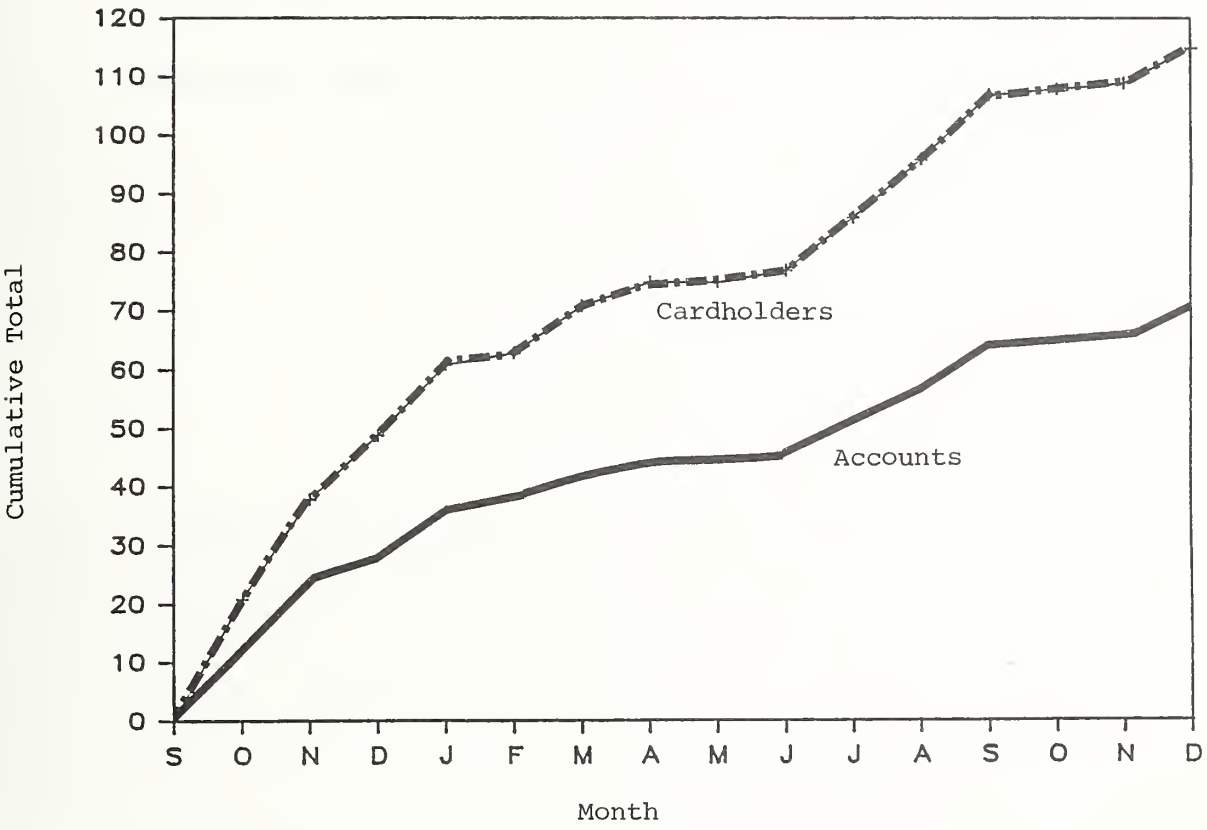


FIGURE 4.2 ACCOUNTS AND CARDHOLDERS: 9/83 - 12/84

Charge-A-Ride is shown in Section 3.) While this analysis is based primarily on the applications, the survey data does contribute information on transit usage patterns and transit dependence. It should be noted that a single credit application or application survey may represent more than one person in a family or agency. Since not all these persons can be expected to share identical background traits or transit use patterns, the results of any analysis of application data are likely to understate the variation that exists among the pool of individual Charge-A-Ride users.

Age of Applicants--The median age of all applicants to Charge-A-Ride is 30 years and the simple mean is 24 years. Accepted applicants have a median average age of 34 years and a simple mean age of 37 years. The distribution of applicants by age group and card approval status is shown in Table 4.2. Examination of the rightmost column shows that the distribution of ages for all MVRTA Haverhill riders (in 1982) is quite different. A large proportion of the ridership in the general survey (21.7 percent) was elderly (more than 65 years) while only 5.8 percent of Charge--A-Ride applicants were over 65. The 1982 MVPC ridership study classified riders between 25 and 59 into "working age" riders and 51.8 percent of respondents were in this group. For the Charge-A-Ride services, 61.0 percent of all applicants and 62 percent of accepted applicants were of working age, suggesting a high preponderance of workers in the Charge-A-Ride applicant and user pool.

Only 16 applicants were denied credit. Almost half of these were less than 24 years of age.

TABLE 4.2 AGE DISTRIBUTION OF CHARGE-A-RIDE CARD APPLICANTS BY ACCEPTANCE STATUS

Age	Applicants Accepted		Applicants Denied		All Applicants		1982 Survey
	#	%	#	%	#	%	%
24	14	19.7	6	38.0	20	23.0	11.9
25-59	44	62.0	9	56.0	53	61.0	51.8
60+	7	9.8	1	6.0	8	9.2	33.6
?	6	8.5	0	-	6	6.8	2.7
TOTAL	71	100.0	16	100.0	87	100.0	100.0

Income of Applicants--No questions related to income were included on the 1982 on-board survey. However, an examination of income from the U.S. Census for Haverhill shows that 20.1 percent of residents made more than $12,000 per year in 1979, or assuming equal monthly distribution, $1,000 per month. Adjusted using the consumer price index, $1,000 per month in 1979 was approximately $1,372 in 1984.[1] Within the approved applicant pool, 58 persons reported their income on the application form. Based on the actual income reported, 17 of 58 approved applicants (29.3 percent) made more than $1,372 per month in 1983 and 1984. Thus, it appears that approved card applicants have a somewhat higher income distribution than the rest of Haverhill. This finding is consistent with the expected income characteristics of approved card applicants versus both non-applicants and denied applicants.

[1]Monthly income in 1984 = Y12 (1979 Annual Income) x (CPI_{84}/CPI_{79})

Examination of the income distribution of the denied applicants shows that all of the applicants responding to the income portion of the form had monthly incomes less than $1,372. This may help to explain the number of younger applicants who were denied credit.

Overall, 65 of 87 applicants or 75 percent had incomes less than $1,372. The grouped distribution of incomes for approved, denied and all applicants are shown in Table 4.3.

TABLE 4.3 MONTHLY INCOME OF CHARGE-A-RIDE APPLICANTS BY CARD APPROVAL STATUS

	Approved			Denied			All		
Monthly Income	#	%	Cum.	#	%	Cum.	#	%	Cum.
Unknown or $0	13	18.3		4	25.0		17	19.5	
$1-$249	5	7.0	25.3	1	6.2	31.2	6	6.9	26.4
$250-$499	12	16.9	42.2	1	6.2	37.4	13	14.9	41.3
$500-$749	12	16.9	59.1	4	25.0	62.4	16	18.4	59.7
$750-$1,000	6	8.5	57.6	1	6.2	68.6	7	8.0	67.7
$1,001-$1,499	11	15.5	83.1	4	25.0	93.6	15	17.2	84.9
$1,500-$1,999	7	9.9	93.0	1	6.2	99.8	8	9.2	94.1
$2,000 and up	5	7.0	100.0	0			5	5.7	99.8
	71			16			87		

Employment Status--As shown in Table 4.4, none of the approved applicants were unemployed at the time of application, while 2 of the denied

applicants were without work. In addition, 15 approved applicants and 1 denied applicant were not in the labor force (e.g. homemakers). Apparently, employment status alone was not a deciding factor in granting credit to applicants.

TABLE 4.4 CARD APPLICANT EMPLOYMENT STATUS

Employment Status	Approved #	Approved %	Rejected #	Rejected %	Total #	Total %
Employed	52	73.3	14	87.5	81	78.6
Not in Labor Force	15	21.1	0	0.0	16	15.5
Unemployed	0	0	2	12.5	2	1.9
Status Unknown	4	5.6	0	0	4	3.9
TOTAL	71	100.0%	16	100.0%	103	100.0%

Transit Usage History--Most Charge-A-Ride applicants, according to their application survey responses, have been MVRTA riders for more than a year. Only 28 percent of applicants have ridden MVRTA buses for less than a year, while 42 percent have ridden more than two years (see Table 4.5).

Within the ridership as a whole, 45.5 percent of riders had ridden MVRTA buses for at least two years, while 26.6 had been riding less than a year. Apparently, the differences are minor and the Charge-A-Ride applicants are relatively experienced users of the system.

TABLE 4.5 DURATION OF TRANSIT SYSTEM USAGE FOR APPROVED CHARGE-A-RIDE APPLICANTS

Duration of MVRTA Use	#	%	MVRTA Ridership Percentage
Unknown	0	0.0	4.2
Never Used	5	10.0	-
Less than 2 months	5	10.0	-
Two to Six months	3	6.0	-
Six Months to One Year	6	12.0	26.6 (up to 1 yr.)
One to Two Years	10	20.0	22.9
More than Two Years	21	42.0	45.5
	50	100.0	99.2

Transit Use Level--Table 4.6 shows that of the 50 accepted applicants who responded to the application survey, 64 percent travelled on the MVRTA at least five times a week, and 38 percent used the bus at least 10 times a week (based on the number of one-way trips). The 1982 ridership study found that 80.4 percent of riders took the bus four or more days per week. There is no direct comparison between these utilization rates, but it appears that a large proportion of the accepted applicants are regular riders, as are Haverhill riders in general.

Examination of Table 4.7 shows that Charge-A-Ride applicants have used many of the other MVRTA services such as the intercity bus, pre-paid ticket books, and special fares.

TABLE 4.6 FREQUENCY OF ONE-WAY TRIPS ON MVRTA BUSES (DURING WEEK PRIOR TO SURVEY) FOR APPROVED CHARGE-A-RIDE APPLICANTS

One Way Trips	#	%	Cum. %
0	5	10.0	10.0
1-4	13	26.0	36.0
5-9	13	26.0	62.0
10 or more	19	38.0	100.0
TOTAL	50	100.0	

TABLE 4.7 USE OF OTHER MVRTA SERVICES FOR APPROVED CHARGE-A-RIDE APPLICANTS (MORE THAN ONE RESPONSE POSSIBLE)

	#	%
Pre-Paid Ticket Books	20	40.0
WEEBUS	1	2.0
Student Reduced Fare Program	7	14.0
Senior Citizen Fare Program	7	14.0
Handicapped Fare Program	3	6.0
Lawrence Downtown Shuttle	9	18.0
Intercity Route 01	22	44.0
Other MVRTA Service	5	10.0

Physical Impairment to Mobility - Only 8 percent of applicants indicated any physical impairment restricting their mobility. It is interesting to note, however, that handicapped cardholders were frequent users of the system. Within the general ridership, 12.6 percent indicated some

form of mobility impairment. Many Haverhill routes are served by handicapped accessible vehicles.

Summary of Applicant Characteristics--The following general observations can be made from this review of applicant characteristics:

- Charge-A-Ride applicants are younger than the general ridership and most accepted applicants are of working age. Denied applicants tend to be lower in age, many under 20 years.
- Charge-A-Ride applicants have slightly higher incomes, and accepted applicants have higher incomes than Haverhill residents generally. Denied applicants appear to have a similar income distribution to the approved applicants.
- Approved Charge-A-Ride applicants are jobholders or not in the labor force. Unemployed persons did not receive Charge-A-Ride cards.

4.3 PATTERNS OF CARD UTILIZATION

This section presents a simple breakdown of Charge-A-Ride usage by time period and by type of card. It is apparent that Charge-A-Ride usage patterns are very similar to those of the Haverhill system. The service offered by the MVRTA is largely a work trip service, in that the majority of both Charge-A-Ride and other users travel only during peak hours. This is easily verifiable by both informal counts of midday passengers, and MVRTA statistics compiled by the MVATC (management company) which show that 68 percent of Haverhill passengers traveled during the peak hours of a sample month (January 1984).

During the course of the demonstration, the MVRTA provided monthly records of charge card use on diskettes to Cambridge Systematics. Charge records on diskettes include both trips recorded with the on-board devices

as well as trips entered manually by Charge-A-Ride staff from driver records. Usually, the records were transferred directly from the on-board cassette tapes to the computer diskettes for further processing. Trips entered manually helped prevent revenue losses due to AFIR malfunctions or processing problems. In addition, drivers were asked to record the number of Charge-A-Ride patrons manually as a check on the on-board devices. Trips were entered on the driver revenue sheets as shown in Figure 4.3. When a Charge-A-Ride trip recorded by the driver was not shown in the computerized records, the supervisor at the MVRTA garage was contacted and asked to verify that the trip was taken.

Based on these charge records, the total number of charged trips was determined for each month. Table 4.8 shows the total number of charged trips and the total passenger trips using all forms of fare payment by month during the demonstration on the MVRTA Haverhill routes.

The patterns of card utilization, like the patterns of application to the Charge-A-Ride program, might be expected to show the two periods of initial intense use and subsequent decline. However, this a priori expectation is not reflected in the actual pattern of card utilization. The observed trend in use has been upwards and has not yet revealed a downturn in frequency of any significance.

Use by Time Period--Charge-A-Ride use occurs predominantly during the peak hours, presumably for work trips. This trip purpose assumption is supported by the fact that almost all accepted applicants are employed rather than retired, handicapped, or students. The Haverhill system is

Shift HA 2A Day WED. Date 3/6/85

Driver WELCOME Bus # 277

☐ 9 a.m. ☐ Mid-day ☐ 3 p.m. ☐ 6 p.m.

Revenue	9.25 / 10.25		
Fare A	—		
Fare B	—		
Fare 1	5		
Fare 2	4		
Fare 3	—		
Fare 4	1		
Fare 5	—		
Fare 6	—		
Fare 7	3		
Fare 8	12		
Fare 9	—		
Fare 10	-		
Tickets	—		
Tokens	—		

REMARKS:

TIME	ROUTE	TRANSFERS
5:25 - 9:25	13	1
	18	—
	19	—

10 Ride Tickets

TIME	ROUTE	FF	E/H	S
5:25 - 9:25	13	1	1	—
	18	2	3	2
	19	—	—	—

CHARGE-A-RIDE

ACC. NO.	ROUTE	TIME
2200507	13	6:34
√√√√√√		

FIGURE 4.3 EXAMPLE DRIVER REVENUE SHEET

TABLE 4.8 CHARGE-A-RIDE TRIP AND TOTAL PASSENGERS BY MONTH ON MVRTA HAVERHILL ROUTES

Date	Charge-A-Ride Trips	Percent of All Trips	Total MVRTA Haverhill Passengers[1]
11/83	111	1.02%	10,900
12/83	210	1.49%	14,081
1/84	225	1.95%	11,519
2/84	314	2.71%	11,550
3/84	362	2.45%	14,795
4/84	379	3.18%	11,918
5/84	385	2.73%	14,122
6/84	413	3.76%	10,974
7/84	338	3.74%	9,046
8/84	499	4.05%	12,322
9/84	449	3.90%	11,506
10/84	624	4.43%	14,084
11/84	573	5.34%	10,734
12/84	570	4.97%	11,472
TOTAL	5,452	3.23%	169,023

[1] Includes total weekday and weekend passengers on Haverhill routes only. Excludes Haverhill Intercity (01) ridership.

Source: MVATC, MVRTA Charge-A-Ride Charge Records

highly peaked in utilization, and the Authority provides special employment services during work hours. Table 4.9 shows a breakdown of Charge-A-Ride trips by time period. The ratio of peak trips to off-peak trips is approximately 4.5:1 while the peak/base ratio of the overall system is closer to 2.5:1 and the ratio of peak/offpeak passenger trips is 2:1.

Use by Card Type--Two types of cards are issued by the Charge-A-Ride program in four categories of payment -- cards for Adult passengers paying full fare; and for those paying special fares cards for senior, handicapped and student, differentiated by color for driver identification. The majority of charged fares were made using adult cards. The percentages for all categories are shown in Table 4.9 which also displays the proportion of trips by each cardtype for the AM and PM peak and midday offpeak periods. It is interesting to note that more trips were made by handicapped individuals than by elderly cardholders. The opposite relationship would normally be expected due to the relatively infrequent use of public transportation by the handicapped. However, the relatively frequent use of Charge-A-Ride by the handicapped is readily explainable. A local occupational therapy center is a subscriber to the Charge-A-Ride program and offers the card to its clientele as a service. These individuals make almost daily use of the bus system and their usage level is correspondingly high in the charge records. In addition, all buses on Haverhill routes offering Charge-A-Ride are accessible to the handicapped. As might be expected, the proportion of elderly users of all trips is higher during the midday than during the peak periods, while

TABLE 4.9 CHARGE-A-RIDE USAGE BY CARD TYPE AND TIME PERIOD

Card Type	AM Peak	Midday	PM Peak	Total
Adult	1,761	650	1,430	3,841
Col. %	.69	.65	.76	.70
Row %	.46	.17	.37	-
Handicapped	472	118	331	921
Col. %	.18	.12	.17	.17
Row %	.51	.13	.36	-
Elderly	235	199	105	539
Col. %	.09	.20	.06	.10
Row %	.44	.37	.19	-
Student	96	29	26	151
Col. %	.04	.03	.01	.03
Row %	.64	.19	.17	-
Total	2,564	996	1,892	5,452
Row %	.47	.18	.35	

handicapped use forms a higher proportion of peak trips than midday trips. In fact, the proportion of handicapped trips charged is almost identical between the morning and evening peak periods.

Weekend Use--Very little charge activity occurred on weekends--only 143 of 5,799 trips made or 2.5 percent. The predominance of weekday use further suggests that regular work trippers account for the majority of Charge-A-Ride users and activity. Weekend service is only offered on Saturdays, with relatively low frequencies (approximately once hourly) between 9:00 AM and 5:00 PM.

Individual Usage--The above discussion does not differentiate usage by individuals. However, when compiling the usage statistics from actual billings, it became clear that a core group of individuals accounted for the majority of Charge-A-Ride usage, with a number of other persons using the charge service only infrequently. Of the 74 active accounts, 21 used the card more than 100 times during the demonstration and only 9 used Charge-A-Ride for more than 200 trips. Of 5,452 total trips, 4,343 originated from those users who charged more than 100 trips.

4.4 EFFECTIVENESS OF CHARGE-A-RIDE MARKETING EFFORTS

In certain situations, marketing efforts can stimulate the use of special services and increase productivity. During most of the Charge-A-Ride demonstration, there were significant expenditures for advertising in several media. Examination of both the application history and the card usage patterns suggest that marketing efforts had little or no effect on either increasing applications to the program or in stimulating use of

the system. This section explores the effectiveness of the marketing strategies described in Section 3.

Results of the on-board survey indicate that the marketing objective of developing awareness of the Charge-A-Ride program was successful. The vast majority (93.3 percent) of those surveyed had heard of the program, and of those who were familiar with the program, 78.6 percent did not want additional information. (A survey of riders on MVRTA's Lawrence routes, which did not have Charge-A-Ride service available, also indicated a high level of awareness (52.7 percent) of the program.) Based on the survey, bus advertising was the most effective media (61.9 percent recalled seeing signs on MVRTA buses), and radio was the least effective (4.8 percent recall). Newspaper advertisements were recalled by 21.4 percent. The Application/User Opinion Survey had similar results: 47.6 percent reported seeing bus signs, 23.8 percent saw newspaper advertisements, and 7.1 percent heard an MVRTA radio spot.

There is no evidence that the marketing program had any direct impact on the number of Charge-A-Ride applications received or on the rate of card usage. Over the course of the demonstration, a total of 107 applications were received, 32 of which were rejected for several reasons. Based on Table 4.8, a penetration rate of less than 4 percent of all trips was achieved by the Charge-A-Ride program. This fell short of the 20 percent goal set by the project manager. MVRTA's project manager attributes this failure, in part, to the high percentage of riders who are elderly (26.5 percent), a market segment noted for its resistance to credit cards. This finding is consistent with the experience of previous demonstrations regarding elder acceptance of credit card fare payment. In addition,

results of the on-board survey indicated that 45.2 percent of all riders preferred to pay cash for small purchases.

Marketing activities were conducted on a relatively low-key, ongoing basis and after the first months of operation, no special promotions or extensive campaigns were attempted. The project manager stated that more intensive marketing efforts were inhibited by mechanical problems with the card reader machines,* which left MVRTA with an often unreliable product to sell. Consequently, MVRTA held off on additional marketing activities until equipment problems could be solved. The rate of applications and card usage did not vary significantly over the course of the demonstration, which is consistent with the marketing approach taken by MVRTA. As noted in Section 3.4, marketing activities were suspended in March, 1984 due to the high cost per new application received (approximately $130).

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*A significant number of respondents to the User Opinion Survey (30.4 percent) cited frequent machine failures as the major disadvantage of the Charge-A-Ride Card.

5. CHARGE-A-RIDE COSTS AND REVENUES

5.1 OVERVIEW

Determining the costs of operating the Charge-A-Ride program is an important aspect of the evaluation. In addition to normal administrative expenditures, costs were incurred in obtaining consultant services for marketing, technical support of the AFIR machines, and development of a statistical reporting system. The local support provided to the project (in the form of in-kind hours for mechanics and supervisory staff) was also a significant cost to the MVRTA, although this support was clearly a major reason behind the continuity of Charge-A-Ride service throughout the demonstration. An additional cost was fare evasion. Regular monthly billing was used to collect fares for Charge-A-Ride trips. A certain amount of revenue was lost during the demonstration due to non-payment of these billed fares.

Revenues from billed accounts offset the costs of providing the service to some degree, although in the MVRTA context, revenues derived from Charge-A-Ride were relatively small, representing only a modest proportion of total system revenues from all forms of fare payment.

This section focuses first on the costs of providing the service, particularly, the gross and net cost per Charge-A-Ride trip and per system revenue mile, based directly on MVRTA expenditures for Charge-A-Ride. The level of local share and federal grant expenditures are also shown. A summary of the revenue losses due to fraud and delinquent accounts is included in this cost analysis. Revenues generated by Charge-A-Ride during the demonstration are then compared with total system revenues.

5.2 COSTS OF CHARGE-A-RIDE SERVICE

Categories of Expenditures--MVRTA project records show that expenses for Charge-A-Ride arise from several sources. These include:

From Federal Grant Funds

- Labor for Manager, Technical Manager, and Clerical Worker
- Office Overhead Costs e.g. Rent, Utilities
- Computer Leasing Costs
- Costs of Credit Collection
- Revenue Losses
- On-going Marketing Expenses
- Machine Repairs and Maintenance

From Local In-Kind Share

- Adminstrative and Supervisory Labor
- Mechanic Labor
- Miscellaneous AFIR Parts and Supplies

The initial budget allocation for the grant application is shown in Section 3. The following table shows a summary of the expenditures in these categories for 1983, 1984, and for the total project. Examination of the tables shows that almost one-third of the total operating costs (based on local and federal expenditures combined) is allocated to Charge-A-Ride project labor and office overhead. Twelve percent of the budget has been expended on subcontractor repairs to the AFIR machines after refurbishing. Nineteen percent of the expenditures have been in the form of local in-kind labor.

Total monthly expenditures for all categories are shown in Table 5.2, along with a variety of other cost-related information for each month of the project. It is apparent that the costs of running Charge-A-Ride, particularly after service was implemented, have been significant, i.e.,

TABLE 5.1 ANNUAL OPERATING COSTS BY CATEGORY

Categorical Breakdown	1983 Dollars	1983 Percent	1984 Dollars	1984 Percent	Project To-Date Dollars	Project To-Date Percent
Grant Share of Expenses						
ADMINISTRATIVE						
LABOR						
Clerical	$ 8,847	5.65%	$ 6,955.00	3.70%	$ 15,802.00	4.58%
Professional	4,500	2.87	14,467.50	7.69	18,967.50	5.50
Manager	26,602	16.99	22,565.50	11.99	49,167.50	14.26
Benefits	2,475	1.58	2,506.50	1.33	4,981.50	1.45
		27.10		24.71		25.79
OVERHEAD						
Rent	7,500	4.79	7,075.00	3.76	14,575.00	4.23
Utilities	981	0.63	2,742.00	1.46	3,723.00	1.08
Phone	92	0.06	2,169.00	1.15	2,261.00	0.66
Postage	89	0.06	399.00	0.21	488.00	0.14
Evaluation Expe	1,283	0.82	275.00	0.15	1,558.00	0.45
Other	5,607	3.58	1,355.00	0.72	6,962.00	2.02
		9.93		7.45		8.58
COMPUTER						
Lease	0	0.00	0.00	0.00	0.00	0.00
Equipment	3,323	2.12	33.00	0.00	3,356.00	0.97
Supplies	2,385	1.52	1,564.00	0.83	3,949.00	1.15
Billing Software	905	0.58	125.00	0.07	1,030.00	0.30
Other Software	0	0.00	0.00	0.00	0.00	0.00
		4.25		0.92		2.42
CREDIT COSTS						
Bill Collection	40	0.03	121.00	0.06	161.00	0.05
Revenue Losses	0	0.00	3.00	0.00	3.00	0.00
Credit Cards	1,202	0.77	2,178.00	1.16	3,380.00	0.98
		0.79		1.22		1.03
MARKETING						
Radio	0	0.00	0.00	0.00	0.00	0.00
Newspaper	0	0.00	0.00	0.00	0.00	0.00
On-Board	0	0.00	0.00	0.00	0.00	0.00
Professional	11,804	7.54	6,928.00	3.68	18,732.00	5.43
Services		7.54		3.68		5.43
REFURBISH AFIR						
Scope	48,555		35,301.00		83,856.00	
REPAIRS						
Scope	3,184	2.03	11,251.00	5.98	14,435.00	4.19
Ketron	6,005	3.84	20,789.00	11.05	26,794.00	7.77
Other	0	0.00	115.00	0.06	115.00	0.03
GRANT TOTAL	135,379	86.48	138,917.50	73.82	274,296.50	79.57
Local Share of Expenses						
ADMINISTRATION						
MVRTA	9,092	5.81	9,843.00	5.23	18,935.00	5.49
MVATC	7,826	5.00	30,626.00	16.27	38,452.00	11.15
		10.81		21.50		16.65
MAINTENANCE						
Mechanic Labor	2,877	1.84	6,016.00	3.20	8,893.00	2.58
COMPUTER						
Lease	839	0.54	2,291.00	1.22	3,130.00	0.91
OTHER						
Supplies	0	0.00	43.00	0.02	43.00	0.01
Miscellany	29	0.02	115.00	0.06	144.00	0.04
AFIR Parts	500	0.32	334.00	0.18	834.00	0.24
		0.34		0.26		0.30
LOCAL TOTAL	21,163	13.52	49,268.00	26.18	70,431.00	20.43
OPERATING COSTS (excludes machine refurbishment)	$107,987		$152,884.50		$260,871.50	

TABLE 5.2 CHARGE-A-RIDE MONTHLY COSTS: DESCRIPTIVE SUMMARY

MONTH	C-A-R PASS	C-A-R GROSS COSTS	C-A-R PROPORTION SYSTEM COSTS	C-A-R GROSS COST PER TRIP	C-A-R GROSS COST PER ROUTE MILE	C-A-R REVENUES	COST RECOVERY RATE	PERCENT SYSTEM REVENUES	C-A-R NET COST	C-A-R NET COSTS PER TRIP	C-A-R NET COST PER ROUTE MILE
NOV 83	111	$15,897	0.53	$143.22	$1.31	$43.75	0.28%	1.09%	$15,853.25	$142.82	$1.30
DEC 83	210	15,315	0.42	72.93	0.95	80.00	0.52	1.55	15,235.00	72.55	0.94
JAN 84	225	11,244	0.40	49.97	0.88	94.50	0.84	2.21	11,149.50	49.55	0.87
FEB 84	314	10,338	0.29	32.92	0.81	141.25	1.37	3.25	10,196.75	32.47	0.80
MAR 84	362	12,645	0.25	34.93	0.75	155.00	1.23	2.88	12,490.00	34.50	0.74
APR 84	379	11,762	0.27	31.03	0.92	138.00	1.17	3.12	11,624.00	30.67	0.91
MAY 84	385	12,730	0.28	33.06	0.79	156.00	1.23	3.05	12,574.00	32.66	0.78
JUN 84	413	14,051	0.40	34.02	1.05	160.00	1.14	3.77	13,891.00	33.63	1.03
JUL 84	338	17,346	0.22	51.32	1.47	167.10	0.96	4.74	17,178.90	50.83	1.46
AUG 84	499	16,402	0.19	32.87	1.06	205.20	1.25	4.32	16,196.80	32.46	1.05
SEP 84	449	11,433	0.18	25.46	0.91	207.60	1.82	4.68	11,225.40	25.00	0.89
OCT 84	624	12,301	0.15	19.71	0.78	265.80	2.16	4.92	12,035.20	19.29	0.76
NOV 84	573	11,812	0.15	20.61	0.99	236.40	2.00	5.59	11,575.60	20.20	0.97
DEC 84	570	10,820	0.15	18.98	0.86	258.30	2.39	6.15	10,561.70	18.53	0.84
TOTAL	5,452	184,096	0.24	33.77	0.95	2,308.90	1.25	3.64	181,787.10	0.94	33.34

more than $10,000 per month. There was an increase in expenditures after August 1983 due to the addition of a full-time technical manager.

Cost per Charge-A-Ride Trip--Based on monthly expenditure levels, charge revenues and monthly Charge-A-Ride trips, the gross and net cost per trip was calculated and is displayed in Table 5.2. The lowest cost, $18.98 per trip, was achieved in December 1984. The cost per trip based on total trips made and total project expenditures from November 1983 to December 1984 was $33.77, and the net cost per trip is $33.34. Other properties would expect to experience lower costs for operating such a system. For example, a property with an existing revenue department which could accommodate management of Charge-A-Ride with existing labor and overhead resources would have significantly lower costs per trip.

Cost per MVRTA System Revenue Mile--MVRTA statistics on total system revenue miles are available by month during the evaluation period. The gross cost of Charge-A-Ride per route mile has varied from 75 cents to $1.47, with an overall gross rate of 95 cents per revenue mile and a net rate of 94 cents.

Comparison With System Operating Costs--Costs for operating the MVRTA system average approximately $55,000 per month exclusive of Charge-A-Ride costs. Charge-A-Ride cost approximately $13,150 per month from November 1983 to December 1984 ($84,096/14) or 24 percent of total system operating costs. With the addition of extra service in July 1984, system costs rose noticeably (almost double) while Charge-A-Ride costs have not experienced

significant increases during the service period. These increasing system operating costs reduce the relative cost of Charge-A-Ride in comparison to 15 percent of the total.

5.3 REVENUE LOSSES

During the course of the evaluation period a total of $87.40 in revenues was lost due to machine problems. Delinquent accounts amounted to $64.80 by December 1984, spread across 4 accounts, with one account owing $32.80 and another $25.90. One delinquent account owing $10 was collected as of December 1984. In January 1986, the remaining delinquent accounts were written off as lost revenues.

It is worth noting that the total of revenue lost due to deliquency and machine problems is $152.20 or 6.6 percent of total Charge-A-Ride revenues of $2,308.90. In the Naugatuck demonstration, the rate of loss was approximately 3 to 5 percent. The rate of loss in Haverhill is comparable, largely due to the attentiveness of the project staff to potential lost revenue and strong efforts to keep a manual tally of fares to check against the computerized records. The system described in Section 4.3 was not foolproof but did help to reduce machine related losses and also revealed when revenue had been lost.

5.4 CHARGE-A-RIDE REVENUES

Sources of Charge-A-Ride Revenue--Revenues to Charge-A-Ride come from three main sources: processing fees for applications ($2), penalty fees ($5), and trip charges by patrons. Application fees were waived for

initial applicants to the program as an incentive for applying. The approximate total of application fees was $64. Penalty fees totaled $20 for the four accounts referred to a collection agency, although it is not clear that these fees were ever collected.

Trip Revenues and Cost Recovery Rate--During the course of the demonstration, revenues from charged trips grew from only $43.75 during November, 1983 to a maximum of $265.80 in October, 1984. Total revenues were $2,308.90. Examined on a monthly basis, revenues can be expressed as a proportion of total Charge-A-Ride costs. Table 5.2 shows the monthly revenues and cost recovery rate which averages 1.25 percent.

Comparison with System Revenues--During the evaluation period, the MVRTA revenues averaged $4,536.98 per month. Charge-A-Ride revenues grew from less than 2 percent of system revenues to somewhat more than 6 percent of system revenues by December 1984 (See Table 5.2). Overall, the rate was 3.64 percent. The growing system revenue proportion is comparable with the increasing Charge-A-Ride proportion of system ridership shown in Section 4.

6. SUMMARY AND IMPLICATIONS FOR TRANSFERABILITY

6.1 OVERVIEW

The MVRTA Charge-A-Ride project was the first implementation of charge card fare payment in a general revenue service environment. The preceding sections of this evaluation report have examined several characteristics of the MVRTA experience with Charge-A-Ride, including:

- Implementation activities
- Project participation levels
- User characteristics
- Design and effectiveness of marketing efforts
- Operations impacts
- Costs and revenues associated with providing the service

These topics have been presented in this report without any particular discussion of their relationship to the issue of feasibility. This section seeks to pull the factual summaries together and address this issue. Testing the feasibility of the charge card concept within a general revenue service environment was a major objective of the Charge-A-Ride project. Earlier demonstrations involving the technology of charge card fare collection had been implemented within special needs transit environments and as such, did not effectively test the acceptability or feasibility of the concept as a service available to regular passengers.

Evaluating the feasibility of Charge-A-Ride involves several dimensions including:

- Technical success--Did this fare collection method work?
- Public acceptance--Who used the service?
- Cost effectiveness--Were the benefits of providing the service worth its cost?

The remainder of this section examines each of these areas of discussion as a means of both summarizing this evaluation report and discusssing the feasibility of the concept of charge fare postpayment.

6.2 TECHNICAL SUCCESS

The Haverhill demonstration of automated fare postpayment using charge cards was the first implementation of this service which did not have to be discontinued before the expected end of the demonstration period. Other demonstrations were marred by equipment problems and were unable to provide the service continuously using automated fare equipment throughout the demonstration periods. In Naugatuck, CT, the automated method was replaced with manual recording of charged trips and a simpler fare structure was instituted. In Portland, OR, installation difficulties and reliability problems limited the usefulness of automated fare recording as a convenient service for LIFT patrons.

The MVRTA demonstration involved a great deal of effort to monitor the performance of the machines and ensure continued operation throughout the demonstration period. The project paid for extensive refurbishment of the equipment prior to the inauguration of service. More than $5,000 dollars was spent on each machine. The illustrations in Section 3 show that the physical configuration of the machines was completely changed in order to install the units on MVRTA buses. In addition to external changes, the

internal mechanisms were significantly refurbished and altered. These refurbishing efforts were undertaken in light of the experience with the machines gained from the Portland demonstration. Many of the problems encountered there were eliminated in this demonstration.

In spite of the refurbishing, problems still arose with the devices. The most obvious problem was that the reader mechanisms failed to operate reliably in cold weather. This problem was eventually corrected by simply warming up the buses and the machines themselves to minimize the effects of cold weather. However, this also required the dispatcher to arrive much earlier for work to warm up all the devices, start the buses, and test each machine by inserting a card into the reader mechanism. This warm up and testing period meant that the buses were run for fifteen minutes every (cold) morning during the demonstration period solely to keep the charge devices warm and operable.

While undeniably a factor in the success of this demonstration, evaluating the machines was not the major motivation behind this demonstration. The concept of fare post-payment was really under scrutiny. The most important aspect of this project, then, is demonstrating the effectiveness of the technology as a means of collecting fares. The Charge-A-Ride billing hardware and software represents a workable system for processing and tabulating the charge records generated by the on-board equipment, even measured solely by the fact that the project never failed to generate monthly bills in a timely and accurate manner during the course of the demonstration .

However, this continuity of service does not mean that the system was completely foolproof or efficient to operate. Charge-A-Ride relied heavily on manual crosschecking by bus drivers to ensure accuracy and minimize lost revenues and service interruptions. A significant portion of the charge revenue records were entered into the billing system manually from driver revenue sheets. Thus, the Charge-A-Ride fare collection system was partially automated and partially manual, both on the buses and in the management office. In the Haverhill system, keeping track of manual charge records was easy because the revenue sheets were the fundamental check on the honesty of the drivers. This crosschecking procedure is discussed in section 4.3. The revenue check sheets are used because the drivers still make change for MVRTA patrons and their accounts must balance at the end of the day.

Within a larger transit system, the added burden on drivers of recording charge numbers might lead to a great deal of lost revenue, as it is probably unreasonable and unrealistic to expect that all drivers would strictly observe the procedures for recording fares by hand. This would be true particularly during rush hour or peakload conditions. Furthermore, revenue information recorded on little slips of paper has a great potential for getting lost somewhere between the end of a driver's shift and its arrival at the revenue department.

It should be recognized that the modest levels of usage of Charge-A-Ride did not push the system to any extreme. Five hundred or so charge records per month generated by less than fifty active accounts can conceivably be managed with totally manual methods. With much higher usage,

problems could have arisen with the billing system. First, a 3 to 5 percent revenue loss rate was experienced due to faulty recording devices on the buses. While the total revenue lost during the course of the demonstration was only $65 or so, much higher utilization of Charge-A-Ride could have caused higher revenue losses. Second, more sophisticated software and enhanced hardware capacity might have been needed to process a significantly larger number of records. The database management software employed for the MVRTA billing system is quite slow in sorting and totalling operations, both of which are absolutely necessary for preparing bills by account. The hardware used in the MVRTA system was a basic personal computer system using floppy diskettes, which can only store a limited amount of data (approximately 9,000 MVRTA charge records). A much more expensive mass storage device might be needed to maintain charge records generated from a larger system's usage. Finally, the additional work of preparing a much larger number of monthly bills might require more labor and overhead support to manage applications, account management, and other aspects of credit administration.

6.3 PUBLIC ACCEPTANCE OF CHARGE CARD FARE PAYMENT

The Haverhill bus system carries between 300 and 400 riders per day, or somewhat more than 10,000 per month. As of December 1984, Charge-A-Ride represented approximately 5 percent of the total system usage. There were 71 approved accounts and 115 persons involved in the program. However, examination of the actual charge records showed that a few accounts generated a fairly large proportion of Charge-A-Ride usage, while most

accounts were inactive or generated very modest revenues. This suggests a number of conclusions about public acceptance of the concept:

- The MVRTA marketing efforts were relatively effective in generating awareness of the program. Most people knew about the program in Haverhill, based on a small on-board survey. The increasing numbers of approved accounts throughout the demonstration translated directly into increased levels of usage of Charge-A-Ride.

- While many people had Charge-A-Ride cards, it is apparent from a review of billing records that only a few actually used the system with any frequency, and these regular users seemed to be increasing their usage of Charge-A-Ride.

- Generally modest usage levels probably represented use of the charge card as a convenience rather than as a usual means of fare payment.

- There is no demonstrable relationship between increasing Charge-A-Ride usage and overall system ridership levels. Examination of the ridership figures presented in Section 4 reveals that the month-to-month variation in total system ridership is many times the small increments in Charge-A-Ride usage. The logical conclusion is that Charge-A-Ride is a substitute fare payment method for existing riders, and not an inducement to lure new passengers. This is borne out by surveys of Charge-A-Ride cardholders which did not reveal any significant increase in their use of the system with the new fare payment method, nor were there a significant number of new riders among the applicants to the program. Thus, while there was a relatively high level of interest in the program, it was generated within the existing riders.

- The great majority of users were regular adult fare bus patrons, and the largest proportion of usage was during peak hours. Work trips accounted for the bulk of Charge-A-Ride usage.

- Elderly users were a smaller proportion of Charge-A-Ride cardholders than of system riders generally, supporting the premise that the elderly would show the least interest in the concept.

- Handicapped cardholders used the system more than the elderly. This was because a single social service agency made the cards available to its clients, and they used the service on a daily basis, accumulating 927 trips during the demonstration period. This clientele was similar to those of the special needs services in the previous demonstrations and the Haverhill experience suggests that charge cards might be a viable way to provide

transportation assistance to social service clients in lieu of direct cash payments.

- Finally, it appears that the unreliability of the automated fare recording equipment may have inhibited usage. The machines were perceived as somewhat unreliable by many patrons, according to survey results, and many users reported difficulties with operating the on-board equipment. The project manager for Charge-A-Ride also feels that the machines may have lowered the usage.

6.4 COST EFFECTIVENESS OF CHARGE-A-RIDE SERVICE

The costs and revenues of the Charge-A-Ride program were summarized in Section 5. A significant amount of money was spent to operate the program in order to collect a relatively small amount of revenues. Charge-A-Ride has proven to be an expensive service to operate. The lowest cost per Charge-A-Ride trip over the course of the demonstration was $18.98 or 36 times the average system fare. In a typical transit system, one would expect to pay 10 to 15 percent of the value of a fare in order to collect it. With Charge-A-Ride, the cost recovery from revenues was on the order of 1 to 2 percent of total fare collection costs.

This poor rate of recovery is somewhat overstated for several reasons. In other settings, the implementation of charge card service might be able to take advantage of certain economies of scale. Administration of the credit program by existing employees, rather than employees hired specifically to manage the charge service would reduce labor requirements. Computer support could be provided by an existing MIS or accounting/revenue department. Field maintenance could be added to the daily responsibilities of an existing mechanic staff. Modern charge recording mechanisms using magnetic strips might be more reliable and require less effort to ensure availability of charge service.

The demonstration has shown that automation of the process is feasible, and if the process could be more fully automated, this would further reduce manual intervention in the billing process and consequently lower the related labor costs. Such cost reductions would have to be realized before charge card payment could reasonably be implemented in other transit agencies.

6.5 IMPLICATION FOR TRANSFERABILITY

This evaluation has deliberately downplayed the importance of technical machine-related problems because all parties involved with this project agree that the machines themselves are obsolete. Any full-scale implementation of charge card or other non-cash, non-token fare collection method would require an innovative, reliable technology to ensure success. Lower maintenance costs, decreased revenue losses and simpler fare data management would all be salient features of such a system. Currently, such devices are beginning to make an appearance. The swipe pass reader/fare counter manufactured by Cubic Western Data is a hybrid example which combines pass verification capabilities and cash fare management in one device.

If similar advanced fare collection devices were available for credit or debit card reading, it is not unreasonable to conclude that cashless fare payment has some potential in a general revenue service environment. Clearly, the Haverhill demonstration has shown that the public is willing to use such a service, and that viable administrative procedures can be installed to manage this type of fare collection. The modest level of

usage in Haverhill makes any general conclusion about the transferability of the findings of this demonstration to other properties somewhat questionable. However, with reliable technology and economies of scale in fare data management, thereby generating lower operating costs, this method of fare collection might be a practical alternative to cash methods. Further demonstrations in larger systems would be needed to verify this hypothesis.

APPENDIX I

COMPARISON OF FARE PAYMENT TIMES FOR CHARGE-A-RIDE AND OTHER PAYMENT METHODS

Boarding delays due to card use are a potential source of problems with the use of on-board fare recorders for fare post-payment. If credit card fare payment takes more time than the other methods, schedule adherence problems may arise. In order to determine whether there is any observable difference, a simple experiment was set up. An experimental method was required because the relatively modest usage levels of Charge--A-Ride made gathering a reasonable number of Charge-A-Ride payment times difficult to accomplish on board buses in service.

Times were recorded for several methods of fare payment using volunteers boarding a bus parked in an MVRTA garage. While an imperfect means at best for determining payment times, the results, viewed in a qualitative fashion, do suggest that there are discernible differences between the various payment methods.

Several caveats must be stated with respect to the analysis of this information:

- The assumption of random sampling implicit in normal distributions and associated measures of central tendency is violated in this experimental situation. Only a few volunteers were used and they were "homogenous" in age, agility, etc. No elderly persons participated for example. Thus, the times were not drawn from a heterogenous population of general users. It is reasonable to assume that there is some relationship between patron characteristics and the type of fare payment method they employ, and how rapidly or slowly they pay.

- A relatively small number of observations are available. This affects the measures and makes significance tests less reliable.

- Time measurements are prone to systematic errors introduced by the timing device, the timer, and fixing the (arbitrarily) designated beginning and end points for the timing.

Average Times for Different Methods of Fare Payment--The MVRTA uses several different methods of fare payment including cash (including dollar bills with change made), pre-paid tickets, transfer slips, and passes with reduced fare passengers, as well as Charge-A-Ride. A set of observations was also collected with the machine turned off (simulating a breakdown) and a hand recording of charge account information. Table I-1 shows average fare payment times, standard deviations, and the number of observations for several methods.

Significance of Results--By inspection, it appears that using the Charge-A-Ride card with the on board recorder operating is roughly comparable with the methods which do not require the driver to make change. A difference of means test supports the null hypothesis that there is no difference in the times for Charge-A-Ride and exact change (either ready in the hand, not ready, or both ways) at the 95 percent confidence level. Pre-paid tickets apparently are faster than Charge-A-Ride. The same test applied to mean Charge-A-Ride time versus mean time for paying cash with change shows that making change is more time consuming than using the charge card. Payment times for the situation where the machine is working compared to hand recording of charge information shows that the hand recording method takes longer, but not more time than making change for passengers. When transfers are issued at the time of fare payment, the additonal time required for the driver to punch and hand over the slip to the

TABLE I.1 COMPARISON OF FARE PAYMENT TIMES USING DIFFERENT METHODS

Type of Fare Payment	Mean Time in Seconds	Standard Deviation	Number of Observations	Difference of Mean of Method Compared to Automated Charge-A-Ride[1]
Charge-A-Ride				
AUTOMATED (Machine)	6.80	3.30	131	
Manual Recording	10.34	5.58	72	Slower
Exact Fare Cash				
Ready to Pay	6.18	4.02	23	No Difference
Not Ready	7.09	5.46	37	No Difference
Both	6.74	4.98	60	No Difference
Cash with Change				
Pass Presented	12.57	5.61	21	Slower
Dollar Bill	11.70	2.24	20	Slower
Incorrect Coins	13.64	5.34	30	Slower
Any Combination of Bills or Coins	12.86	4.47	50	Slower
Ten-Ride Tickets	5.77	5.80	46	Faster

[1] The fare payment methods are compared to automated Charge-A-Ride using a simple t-test of difference between the mean times.

patron is always longer on average than the time without a transfer slip being issued.

These results, albeit somewhat unreliable, seem to suggest that no particular fare payment time penalty is incurred by the use of automated fare recorders for fare payment. This in turn suggests that operational impacts, particularly bus operating delays, are not likely to be a significant problem in a similar service environment. Implementation of a similar technique of fare collection in a much larger system with higher passenger volumes and vehicle load levels might lead to difficulties, however.

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